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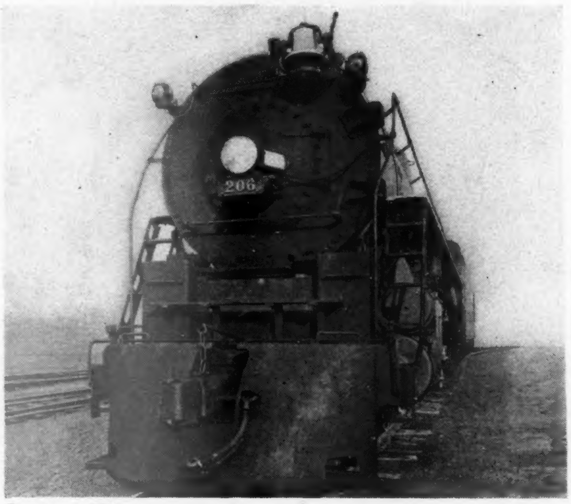

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April, 1938

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General Dimensions, Weights and Proportions of the C.M.St.P. & P. 4-8-4 Type Locomotive

Railroad	C. M. St. P. & P.
Builder	Baldwin
Type of locomotive	4-8-4
Road class	S-2
Road numbers	200-229
Date built	1938
Service	Freight
Dimensions:	
Height to top of stack, ft.–in.	16–0
Height to center of boiler, ft.–in.	10–8
Width overall, in.	130½
Cylinder centers, in.	92½
Weights in working order, lb.	
On drivers	282,320
On front truck	87,800
On trailing truck	120,330
Total engine	490,450
Tender	397,000
Wheel bases, ft.–in.:	
Driving	19– 3
Rigid	12–10
Engine, total	47– 4
Engine and tender, total	96– ½
Wheels, diameter outside tires, in.:	
Driving	74
Front truck	36
Trailing truck, front	38
Trailing truck, back	44
Engine:	
Cylinders, number, diameter and stroke, in.	2–26x32
Valve gear, type	Walschaert
Valves, piston type, size, in.	14
Maximum travel, in.	7½
Steam lap, in.	1¼
Exhaust clearance, in.	⅛
Lead, in.	¼
Cut-off in full gear, per cent	85
Boiler:	
Type	Conical
Steam pressure, lb. per sq. in.	285
Diameter, first ring, inside, in.	$90\frac{3}{16}$
Diameter, largest, outside, in.	100
Firebox length, in.	150
Firebox width, in.	102¼
Height mud ring to crown sheet, back, in.	73⅝
Height mud ring to crown sheet, front, in.	92⅛
Combustion chamber length, in.	72
Arch tubes, number and diam., in.	2–3
Thermic syphons, number	3
Tubes, number and diam., in.	66–2¼
Flues, number and diam., in.	201–3¾
Length over tube sheets, ft.	21–0
Net gas area through tubes and flues, sq. ft.	11.32
Fuel	Soft coal
Stoker	Type B, du Pont Simplex
Grate type	Firebar
Grate area, sq. ft.	106
Heating surfaces, sq. ft.:	
Firebox	294
Comb. chamber	137
Arch tubes	18
Thermic syphons	129
Firebox, total	578
Tubes and flues	4,931
Evaporative, total	5,509
Superheat.	2,336
Combined evap. and superheat	7,845
Feedwater heater, type	Wilson
Tender:	
Type	Water-bottom
Water capacity, gal.	20,000
Fuel capacity, tons	25
Trucks	Six-wheel
Journals, diam. and length, in.	7x14
Rated tractive force, engine, 85 per cent, lb.	70,800
Weight proportions:	
Weight on drivers ÷ weight engine, per cent	57.57
Weight on drivers ÷ tractive force	3.99
Weight of engine ÷ evap. heat. surface	89.02
Weight of engine ÷ comb. heat. surface	62.51
Boiler proportions:	
Firebox heat. surface, per cent comb. heat. surface	73.67
Tube-flue heat. surface, per cent comb. heat. surface	62.84
Superheat. surface, per cent comb. heat. surface	29.71
Firebox heat. surface ÷ grate area	5.45
Tube-flue heat. surface ÷ grate area	46.51
Superheat. surface ÷ grate area	21.94
Comb. heat. surface ÷ grate area	74.02
Gas area, tubes-flues ÷ grate area	0.107
Evaporat. heat. surface ÷ grate area	51.98
Tractive force ÷ grate area	667.9
Tractive force ÷ evap. heat. surface	12.84
Tractive force ÷ comb. heat. surface	9.02
Tractive force × diam. drivers ÷ comb. heat. surface	667.7

tion. Since the peaks of passenger and freight service come at different seasons, neither service interferes with the other in the assignment of the locomotives to both.

The Boiler

The boilers are of the conical-connection type. The barrel courses and welt strips, and the roof and side wrapper sheets are of silico manganese steel.

The joints between all sheets of the firebox and the 72-in. combustion chamber are butt welded. There are two Nicholson Thermic syphons in the firebox and one in the combustion chamber. The syphon flanges are butt welded in the crown. The door flanges in the back head and door sheet are lap welded. After the firebox seams have been welded on the fire side they are chipped out on the water side with a round-nose tool and are then built up on the water side.

An unusual amount of seal welding has been done on this boiler. The calking edges of the seams joining the wrapper and throat sheets to the third barrel course are welded all around. The edges of the wrapper sheets around the back head are welded after the hydraulic test and the tubes and flues are sealed in the back tube sheet by electric welding after the second fire test. The bottom edges of the firebox and wrapper sheets are welded 12 in. each way from each mud-ring corner, and the front edges of the wrapper sheet are sealed 20 in. up from the mud ring. The usual seal welding has been done at the ends of the longitudinal seams in the barrel courses.

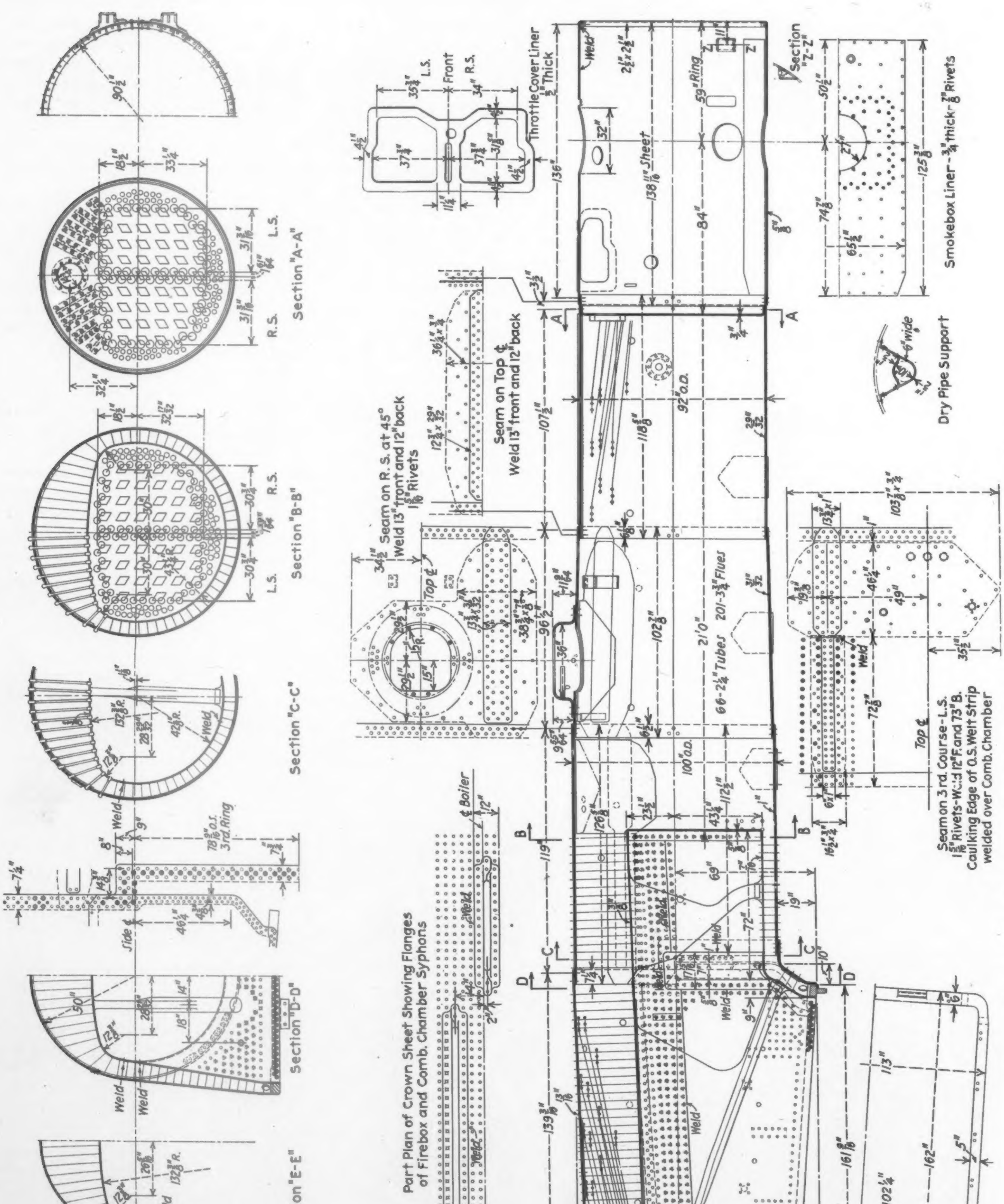
The flexible stays are the Alco type. These are applied in the four top rows below the crown stays throughout the entire length on each side of the firebox and in the two vertical rows each, immediately adjoining the back head and throat sheet. There is a complete installation of flexible stays in the combustion chamber, and the first six transverse rows of crown stays back from the tube sheet are Alco expansion stays. The remainder of the crown stays are rigid radials. There is a complete installation of flexible stays in the throat sheet, except in the top and bottom rows, and they are also applied in the two outside rows around the back head. On five of the locomotives the short rigid staybolts are made of hollow Mayari steel.

These locomotives are fitted with Firebar grates, which provide 20 per cent air openings, and are fired by a Type B du Pont Simplex stoker, the engine of which is mounted in the left front corner of the tank. The boiler equipment includes the Barco low-water alarm and the Wilson sludge remover.

The tender tank design on these locomotives required that the hot well of the Wilson feedwater heater be located about half way back in the tank instead of at the usual location in one of the front corners. The hot well in the new location on the left side of the tender holds approximately 1,000 gallons of water, from which the two-stage centrifugal pump feeds the boiler. To reach the new location the 6-in. exhaust steam return line is carried over the top of the tank. The additional length of exposed pipe, together with the fact that three sides of the hot well are exposed to the temperature of the water in the main tank and one side to the atmosphere, has effected a considerable increase in the amount of condensate returned without depleting the supply of heat below that required to bring the water to the maximum temperature allowed by the setting of the thermostatic control valve. Almost 20 per cent of the water evaporated in the boiler is now returned to the hot well.

The boilers include the Type E superheater, in the header of which is incorporated the American multiple throttle. The dry pipe is fitted with the Tangential steam drier. A departure from the customary method of securing the front end of the dry pipe in the tube sheet has been made in these locomotives. A flange on the collar at the front end of the dry pipe is welded directly to the outside of the tube sheet, thus providing a joint which is permanently steam tight.

The spark arrester is the Anderson open type in which no netting is used. It is a box installed between



Cross-sections and elevation of the boiler of the C. M. St. P. & P. 4-8-4 type locomotives

the bottom of the stack extension and the top of the exhaust nozzle, in the sides and front of which is a series of louvers placed at the proper angles to set up an effective baffling action in the path of the cinders. The smokebox is lagged and jacketed.

The Foundation, Running Gear and Driving Gear

The bed castings of these locomotives include the cylinders and integral back cylinder heads. Main reservoirs are also an integral part of the backbone of the casting and attachments are provided for the air compressors, the headlight generator, the hot-water feed pump, reverse gear, and expansion shoes at each of the four corners of the firebox. The guide-yoke crosstie, valve-motion-frame crosstie, cab-bracket supports and waist-sheet bolting lugs are also integral parts of the casting.

The pilot is of unique construction. It consists of a cast-steel frame to which steel plate is welded, secured to a vertical wall at the front of the engine bed and built so that the sloping surface extends from a point well above the deck to the bottom of the pilot. A folding type coupler is installed and, when not in use, a skirt with which it is fitted completely closes the opening in the pilot. A smooth, unbroken contour is thus provided which is said to have proved quite effective in clearing snow from the track.

The driving wheels are Boxpok cast-steel centers and the journals have Timken roller bearings in one-piece housings. An Alco lateral-motion device on the front driving wheels provides $^{19}/_{32}$ in. lateral on each side.

The main and side rods are of low-carbon nickel steel. There is a complete installation of floating bushings on the crank pins with Hunt-Spiller fixed bushings in the rods. The front end of the main rod has $^{1}/_{16}$ in. lateral play in the crosshead. The knuckle pins are of nickel steel.

All revolving weights are counterbalanced; those in the main wheel are cross-counterbalanced. The total weight of reciprocating parts on each side is 2,287 lb., of which 39.5 per cent is balanced. This produces a calculated dynamic augment at 74 m. p. h. (diametral speed) of 11,285 lb. in each of the first and main wheels; 12,311 lb. in the third wheel, and 11,490 lb. in the fourth wheel.

The engine truck is the General Steel Castings Company four-wheel equalizer type with inside Timken roller bearings. The wheels are 36 in. in diameter and are mounted on hollow-bored axles. These trucks are fitted with the constant-resistance centering device.

The Commonwealth Delta type four-wheel trailer trucks have the American Steel Foundries roller-bearing units on both axles. The front wheels are 38 in. in diameter and the rear wheels 44 in. in diameter. The latter have cast-steel centers fitted with tires. Both axles are provided with ½-in. lateral movement. The engine-truck wheels and front trailer wheels on part of the locomotives are the Davis one-wear cast steel; on the others, Standard one-wear rolled steel.

The cylinder and valve-chamber bushings are of Hunt-Spiller gun iron. The piston heads, of rolled steel, are fitted with Hunt-Spiller gun-iron bull rings and outside packing rings, and bronze inside packing rings.

The guides and crossheads are of the multiple-bearing type. The guides are attached to the cylinder heads with the Slid-Guide expansion support.

The valves are built up of light cast-steel spiders with Hunt-Spiller lightweight bull rings and sectional packing rings on the outside, and bronze rings inside. The piston-rod and valve-stem packing is the T-Z Diamond Crescent type.

The Walschaert valve motion provides a valve travel of 7½ in. The lifting link, the reverse link, the compensating lever, the crosshead link, the eccentric rod and crank, and the motion pins are all of low-carbon nickel steel. The pins are casehardened. The reverse gears on half of the locomotives are Baldwin and on the other half Alco.

Lubrication

Each locomotive has two force-feed lubricators. On the right side is a Nathan Type DV5, 26-pint lubricator which is lagged. There are five feeds, two of which lead to the cylinders, two to the valves and one to the stoker engine. On the left side of each locomotive is an unlagged 24-pint, five-feed lubricator with four-way dividers from each feed. Four of the lines lead to guide terminal checks; the remainder, to driving-box terminal checks for the lubrication of the driving-box shoes. These lubricators are Detroit's on half of the locomotives and Chicago's on the remainder. Air-compressor lubrication is furnished by a Westinghouse force-feed pump lubricator. This lubricator also takes care of the turbo generator.

These locomotives have an extensive installation of Alemite fittings. In addition to the rods and valve motion, these fittings are applied on the brake rigging, spring rigging, truck pedestals and center plates, and to the furnace bearers as well as to numerous other bearing or wearing surfaces on the locomotive and tender.

Cabs and Auxiliary Equipment

The brakes are No. 8ET Westinghouse with two 8½-in. cross-compound compressors. The driving wheels are fitted with long brake shoes. Both the engine truck and the trailer wheels have clasp brakes. The braking ratio on the drivers is 60 per cent; on the engine truck, 45 per cent, and on the trailer, 50 per cent. The locomotives have Union Switch & Signal Company three-indication cab signals.

The saturated-steam turret is located under a housing above the roof sheet in front of the cab and is supplied by two dry pipes opening in the dome. Steam from the turret is delivered to all auxiliaries except the whistle, the turbo generator and the air compressors. Superheated steam is supplied to the whistle, air pumps and turbo generator from a turret on the left side of the smokebox.

Both the air compressors and the generator are installed on the bed casting under the smokebox. The latter is protected by a casing. To avoid outside piping the exhaust from these three auxiliary units is brought together in a header outside the smokebox which is connected to a tunnel that follows the inside contour of the smokebox and discharges into a compartment in the forward section of the smoke stack. This tunnel is welded to the smokebox and spark shields protect it against abrasion. The cavity in front of the stack, with which it is cast integral, contains a deflector so arranged as to serve as a muffler, thus almost entirely damping out the sound of the air-pump exhaust.

As far as possible the piping above the running board has been placed under the jacket and, although not streamline, the locomotive presents a generally neat appearance.

The equipment of these locomotives includes the Ashcroft back-pressure gage and the Chicago Pneumatic Tool Model CT speed recorder.

The cabs are of the vestibule type. A recess in the exterior of the side of the cab at floor height provides a toe hold for passing from the cab to the running board. A suitable handhold is located at the top of the

A 4-8-4 type freight locomotive built for the C. M. St. P. & P. by the Baldwin Locomotive Works

windows. The cabs are wood lined and the sides, roofs and floors insulated. They are fitted with Prime Clear Vision windows of shatterproof glass.

In addition to the seats for the engineman and fireman, drop seats are provided against the rear wall of the cab for the use of the brakeman. When set up, these seats are opposite windows with arm rests in the cab-vestibule doors. All cab seats have Spongex cushions. There are wind shields in front of the vestibule-door windows as well as in front of the engineman's and fireman's positions. The cab ventilator is operated by a gear and rack device in which provision is made for locking so that the ventilator will not creep.

The engine and tender are coupled by a Unit Safety drawbar and a Type E-2 radial buffer. The pipe connections are Barco flexible metallic conduit.

Tender

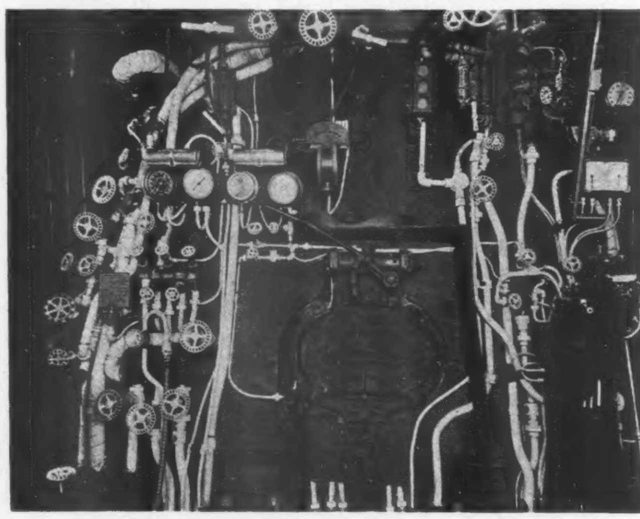
The tender underframe is a General Steel Castings water-bottom type in which the sump for the Wilson feedwater heater is cast integral. The tank is of welded construction throughout.

There are two General Steel Castings six-wheel trucks with an 11-ft. wheel base. These trucks have 38-in. wheels and are mounted on axles with 7-in. by 14-in. journals which are fitted with the American Steel Foundries roller-bearing units with SKF bearings. The wheels on part of the locomotives are Davis one-wear cast steel, and on the remainder Standard one-wear rolled steel. The brakes are the Simplex unit-cylinder clasp type with one brake cylinder per truck and have a braking ratio of 80 per cent of the tender light weight. Miner A-78-XB draft gear is applied at the rear end of the tender.

The principal dimensions, weights and proportions of the locomotives are shown in one of the tables.

Partial List of Materials and Equipment on the C. M. St. P. & P. 4-8-4 Type Locomotives

Firebox steel	Lukens Steel Co., Coatesville, Pa.
Staybolt steel, Mayari (short rigid bolts)	(5) Bethlehem Steel Co., Bethlehem, Pa.
Staybolt iron (other staybolts)	(5) Ewald Iron Co., Louisville, Ky.
Staybolt iron	(25) Joseph T. Ryerson & Son, Inc., Chicago; Blatchford Corp., Chicago
Flexible staybolts and expansion stays	(30) American Locomotive Co., New York
Tubes and flues	Globe Steel Tubes Co., Milwaukee, Wis. National Tube Co., Pittsburgh, Pa.
Arch tubes	Globe Steel Tubes Co., Milwaukee, Wis. National Tube Co., Pittsburgh, Pa.
Nicholson Thermic syphons	Locomotive Fire Box Co., Chicago
Firebrick arch	Universal Locomotive Arch Co., Chicago
Superheater, Modified Type E, and Elesco Tangential steam drier	The Superheater Company, New York
Front-end throttle	American Throttle Co., New York
Smokebox hinges	The Okadee Company, Chicago
Smokebox door gaskets	The Garlock Packing Company, Palmyra, N. Y.
Smoke prevention nozzles and smokebox drain plugs	T-Z Railway Equipment Co., Chicago
Pipe	Reading Iron Company, Philadelphia, Pa. Standard Sanitary Mfg. Co., Pittsburgh, Pa.
Pipe fittings	Crane Co., Chicago Walworth Company, New York
Boiler jacket	Bethlehem Steel Co., Bethlehem, Pa.
Lagging	(24) Johns-Manville Sales Corp., New York
	(3) United States Gypsum Co., Chicago
	(3) Philip Carey Mfg. Co., Lockland, Ohio
Pipe covering	Union Asbestos & Rubber Co., Chicago
Steampipe casing, Flextite	American Locomotive Co., New York
Feedwater heater	Wilson Engineering Corp., Chicago
Injectors and feedwater heater and injector checks	Locomotive Equipment Division of Manning, Maxwell & Moore, Inc., Bridgeport, Conn.
Flue blower	Superior Railway Products Corp., Pittsburgh, Pa.
Blower fittings	Barco Manufacturing Co., Chicago
Blower nozzle	T-Z Railway Equipment Co., Chicago
Sludge remover and exhaust separators; power operated blow-off equipment	Wilson Engineering Corp., Chicago
No-Ox-Id (tank interior and inside cab sheets)	Dearborn Chemical Company, Chicago



The back head of the C. M. St. P. & P. 4-8-4 type locomotive

Washout plugs	(25) T-Z Railway Equipment Co., Chicago
	(5) Huron Mfg. Co., Detroit, Mich.
Strainer	T-Z Railway Equipment Co., Chicago
Stoker, Modified type B du Pont Simplex	Standard Stoker Co., Inc., New York
Stoker gage	Ashton Valve Co., Boston, Mass.
Firedoor, Butterfly	Franklin Railway Supply Co., Inc., New York
Firebar grates	Waugh Equipment Co., New York
Cab insulation, Hairinsul	American Hair & Felt Co., Chicago
Cab apron and deck plate, Firmotread	Joseph T. Ryerson & Son, Inc., Chicago
Running boards, Saf-Car	Irving Iron Works Co., Long Island City, N. Y.
Clear vision windows; windshields	The Prime Manufacturing Co., Milwaukee, Wis.
Cab seat cushions	Sponge Rubber Products Co., Derby, Conn.
Steam valves	(15) Crane Co., Chicago
	(15) Ohio Injector Co., Wadsworth, Ohio
Back pressure gage	Locomotive Equipment Division of Manning, Maxwell & Moore, Inc., Bridgeport, Conn.
Water columns and gage cocks	The Prime Manufacturing Co., Milwaukee, Wis.
Steam gages and safety valves; back-pressure gage	Locomotive Equipment Division of Manning, Maxwell & Moore, Inc., Bridgeport, Conn.
Speed recorder	Chicago Pneumatic Tool Co., New York

(Continued on page 140)

Simplified Formulas for Calculating the

Air Resistance of Trains*

By A. I. Lipetz †

Complex air-resistance formulas are used to develop the simple formulas given in this article — A comparison of the air resistances of streamlined and standard railroad equipment as computed by both types of formulas is made to prove the validity of the simple formulas

HEREIN are presented simplified formulas for evaluating the resistance of air to the motion of railroad motive power and equipment. These formulas are based on data and formulas presented by Professor A. Klemin in a report[1] to the American Locomotive Company, the American Car & Foundry Company and the J. G. Brill Company, which companies sponsored an extensive program of wind-tunnel tests on models of railroad trains in the wind tunnel at New York University during the summer of 1934. In previous articles in the *Railway Mechanical Engineer,* Professor Klemin[2] discussed the procedure for making wind-tunnel tests; G. W. DeBell and A. I. Lipetz[3] discussed the previously mentioned test program, described the types of equipment tested, and gave formulas for evaluating air resistance which are more complicated than those presented in this present article; and G. W. DeBell[4] reviewed that portion of the report[1] which pertains to ground winds.

In the previously mentioned test program, the following types of equipment were studied:

1—Streamlined power car with two types of streamlined nose, and standard and faired trucks.

2—A tail car with two types of tail, and standard and faired trucks.

3—Intermediate streamlined cars with standard and faired trucks, and also open and closed skirts.

4—A streamlined 4-6-4 Hudson-type locomotive with three types of nose, i. e., helmet, round and straight; two types of boilers, i. e., round top and cowled top; and three types of shroud, i. e., long, short and open.

5—A standard 4-6-4 Hudson-type steam locomotive.

6—Standard cars which were tested with the standard locomotive.

7—Streamlined 4-4-4 locomotives with round-top and cowled-top boilers.

8—A standard 4-6-4 steam locomotive.

Equipment mentioned in paragraphs 1, 2, 3, 4, 5 and 6 were made to 1⁄16 scale while the locomotives mentioned in paragraphs 7 and 8 were made to 1⁄32 scale. Much of this equipment was illustrated and described by DeBell and Lipetz in a previous article,[3] who also discussed the tests conducted with it.

Full-Scale Formulas and Their Simplification

Klemin has reported that full-scale air resistance can be established as

$$R_a = R_p + R_f \quad \text{.......................} [1]$$

$$R_a = K_p V^2 + K_f V^{1.85} \quad \text{....................} [2]$$

were R_a is the total air resistance, R_p is the head-end pressure resistance, R_f is the resistance due to skin-friction drag, K_p is the coefficient for head-end pressure resistance, K_f is the coefficient for resistance due to skin-friction drag, and V is velocity in m. p. h. Values of K_p and K_f for all the tests[1] are given in Table I. For example, the air resistance for a streamlined steam locomotive with tender and tail car and corresponding nose, boiler and shroud can be expressed as

$$R_a = 0.1126V^2 + 0.0535V^{1.85}$$

where $K_p = 0.1126$ and $K_f = 0.0535$ were taken from test No. 21 in Table I.

The method of expanding the coefficients from model tests to full-scale equipment, proposed by Klemin,[1] is based on scientific grounds and has the advantage that the coefficients K_p and K_f are constant, that is, they are the same for models and full-scale equipment. In the report made by Klemin,[1] a formula of the two-member type, such a formula [2], is given for each type of equipment tested.

After the report[1] was made, the author of this article wished to find out what is to be gained by using the two-member formula, in which one of the terms has the unusual exponent of 1.85, and whether the one-member formula of the V^2 type, such as equation [7], would not do; in case it should, the author wanted to know what error this simplification would involve.

Therefore, the author developed a one-member formula for determining the air resistance of all the types of equipment enumerated in Table I. He then computed the air resistance of each type, using both Klemin's two-member formulas and his own one-member formulas, and found that the results obtained with both formulas were practically identical, thus justifying the use of the one-member formulas. To illustrate this fact, the author will show how the one-member formulas were developed for (1) the streamlined power car with a tail car and two streamlined coaches used in Test No. 18, and (2) the standard locomotive and tender used in Test No. 28. He will then compare the results obtained with one-member and two-member formulas for these two types of equipment.

The formula recommended by Klemin[1] on the bases of Test No. 18, results of which are given in Table I, is

$$R_a = 0.1116V^2 + 0.0774V^{1.85} \quad \text{................} [3]$$

The author calculated the air resistance of the equipment used in Test No. 18 for speeds at intervals of m.p.h. from 10 to 120 m.p.h. and plotted the results as

* Abridged from the paper "Air Resistance of Railroad Equipment," by A. I. Lipetz, which was published in the Transaction of the American Society of Mechanical Engineers, vol. 59, No. 7, October, 1937, pp. 617-640.

† Chief Consulting Engineer, in charge of research, American Locomotive Company, Schenectady, N. Y.

[1] "Wind Tunnel Test Report No. 717," "Daniel Guggenheim School of Aeronautics, New York University, New York, N. Y., July, 1934.

[2] "Aerodynamics of the Railway Train," by A. Klemin, *Railway Mechanical Engineer,* vol. 108, August, September and October, 1934, pp. 282, 312 and 357, respectively.

[3] "Air Resistance of Passenger Trains," by G. W. DeBell and A. I. Lipetz, *Railway Mechanical Engineer,* vol. 109, December, 1935, p. 496.

[4] "Effect of Natural Winds on Air Drag," by G. W. DeBell, *Railway Mechanical Engineer,* vol. 110, April, 1936, p. 145.

Table I—Results of Drag Tests Made With Models at New York University

Test No.	Equipment	Skirt	Power truck	Trailing truck	Diaphragm	Tail fairing*	Type of nose†	Type of boiler	Type of Shroud	Scale of model	K_p	K_f	K	a	A, sq. ft.	Per cent error of KV^2 at‡ 30 m.p.h.	120 m.p.h.
18	P+T+2SC	Open	Faired	Standard	Smooth	No. 2	No. 2	..	.....	1/16	0.1116	0.0774	0.1503	0.001691	88.89	-4.9	+0.63
18A	P+T+2SC	Open	Faired	Standard	Cowled	No. 2	No. 2	..	.....	1/16	0.1149	0.0774	0.1536	0.001728	88.89	-4.8	+0.62
19	P+T+1SC	Open	Faired	Standard	Smooth	No. 2	No. 2	..	.....	1/16	0.0882	0.0614	0.1189	0.001337	88.89	-4.9	+0.64
20	P+T	Open	Faired	Standard	Smooth	No. 2	No. 2	..	.....	1/16	0.0744	0.0437	0.0962	0.001082	88.89	-4.4	+0.51
21	SL+T	Open	....	Standard	Smooth	No. 2	H	RT	Closed	1/16	0.1126	0.0535	0.1393	0.001010	137.98	-3.6	+0.58
22	SL+T	Open	....	Standard	Smooth	No. 2	R	RT	Closed	1/16	0.1152	0.0535	0.1419	0.001029	137.98	-3.6	+0.50
23	SL+T	Open	....	Standard	Smooth	No. 2	S	RT	Closed	1/16	0.1147	0.0535	0.1414	0.001025	137.98	-3.6	+0.50
24	SL+T	Open	....	Standard	Smooth	No. 2	H	CT	Closed	1/16	0.1161	0.0535	0.1428	0.001035	137.98	-3.5	+0.57
25	SL+T	Open	....	Standard	Smooth	No. 2	H	RT	Open	1/16	0.1156	0.0535	0.1423	0.001032	137.98	-3.5	+0.57
26	SL+T	Open	....	Standard	Smooth	No. 2	H	RT	Short	1/16	0.1308	0.0535	0.1575	0.001142	137.98	-3.3	+0.39
27	SL	....	....	....	......	....	H	RT	Closed	1/16	0.1094	0.0363	0.1275	0.000924	137.98	-2.8	+0.31
28	NL	....	....	....	......	....	....	..	.....	1/16	0.2400	0.0421	0.2611	0.001906	136.96	-1.7	+0.21
29	NL+1NC	....	....	....	......	....	....	..	.....	1/16	0.3103	0.0636	0.3420	0.002498	136.96	-1.8	+0.20
30	NL+2NC	....	....	....	......	....	....	..	.....	1/16	0.3709	0.0830	0.4124	0.003011	136.96	-1.9	+0.27
31	NL+3NC	....	....	....	......	....	....	..	.....	1/16	0.3975	0.1023	0.4486	0.003276	136.96	-2.2	+0.16
32	NL	....	....	....	......	....	....	..	.....	1/32	0.2337	0.0421	0.2547	0.001859	136.96	-1.7	+0.19
33	NL+1NC	....	....	....	......	....	....	..	.....	1/32	0.3025	0.0636	0.3343	0.002441	136.96	-1.8	+0.23
34	NL+2NC	....	....	....	......	....	....	..	.....	1/32	0.3518	0.0830	0.3933	0.003871	136.96	-2.1	+0.26
35	NL+3NC	....	....	....	......	....	....	..	.....	1/32	0.4082	0.1023	0.4593	0.003353	136.96	-2.2	+0.27

Notations: P = power car; T = tail car; SC = streamlined car; SL = streamlined locomotive; NL = nonstreamlined (standard) locomotive; NC = nonstreamlined (standard) car; H = helmet-type nose; R = round nose; S = straight nose; RT = round top; CT = cowled top.

* The No. 2 streamlined tail fairing mentioned in this column is illustrated in Fig. 5 of the article "Air Resistance of Passenger Trains," by G. W. DeBell and A. I. Lipetz, *Railway Mechanical Engineer*, vol. 109, December, 1935, p. 497.

† The No. 2 nose mentioned in this column is illustrated in Fig. 4 of the article referred to in the preceding footnote. The helmet, round and straight noses are illustrated in Fig. 11 of the same article.

‡ Errors are in relation to ($K_pV^2 + K_fV^{1.85}$).

crosses in Fig. 1. He then found that the resistances so plotted can be represented very well by the parabolic one-member formula

$$R_a = KV^2 = 0.1503V^2 \quad \ldots\ldots\ldots\ldots [4]$$

The parabolic curve was found by the method of least squares. The differences in resistances obtained by formulas [3] and [4] are given in Table II. This justi-

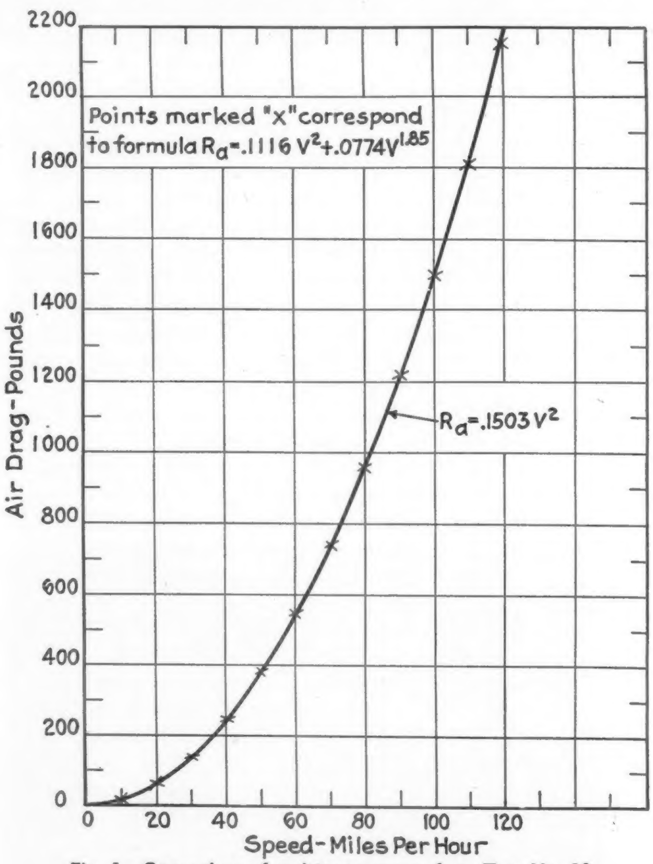


Fig. 1—Comparison of resistance curves from Test No. 18

fies the use of the one-member formula, because the difference is negligible; at low speeds the percentage difference may seem large, but actually it amounts to a few pounds. At high speeds (about 100 m.p.h.) it is less than a small fraction of one per cent. Besides, small speeds, below 50 m.p.h., are now of little practical interest.

All two-member formulas derived from the tests were similarly analyzed and the results were the same. It was found that every two-member formula, of the type such as formula [1], can be replaced by a one-member formula of the type such as formula [4]. This is true not only for streamlined equipment, but for nonstreamlined

Table II—Comparison of Air Resistances Obtained by Using Formulas [3] and [4]

Speed, m.p.h.	R_a from formula [3], lb.	R_a from formula [4], lb.	Difference, per cent
10	16.6	15.0	-9.67
20	64.4	60.1	-6.63
30	142.3	135.3	-4.92
40	249.8	240.5	-3.72
50	386.6	375.8	-2.81
60	552.5	541.1	-2.07
70	747.4	736.5	-1.46
80	971.0	961.9	-0.93
90	1,223.2	1,217.4	-0.47
100	1,503.9	1,503.0	-0.06
110	1,813.1	1,818.6	+0.31
120	2,150.6	2,164.3	+0.64

equipment as well. In Fig. 2 a comparison of curves for a standard locomotive and tender (test No. 28) is made. The formula resulting from the test and recommended by Klemin[1] is

$$R_a = 0.2400V^2 + 0.0421V^{1.85} \quad [5]$$

and is represented by the crosses for speeds between 10 and 120 m.p.m. The curve shown in Fig. 2 is a one-member parabola

$$R_a = 0.2611V^2 \quad [6]$$

The comparison of air resistances obtained by formulas [5] and [6], is given in Table III.

It seems that the air resistance of a nonstreamlined locomotive can be represented by a V^2 formula better than a streamlined locomotive. This can be explained by the fact that the nonstreamlined locomotive causes more turbulence, which follows the V^2 law, while the streamlined locomotive has more skin friction, which follows the law with an exponent of 1.85. In either case the V^2 formula can be used for all practical purposes.

One remark would not be amiss here in this connection. It should not be thought that, because of the admissibility of the V^2 law, we could, for establishing the full-scale formulas, expand the coefficient from the model tests simply by increasing their values in the inverse ratio of the square of the scale, as being done by some experimenters.

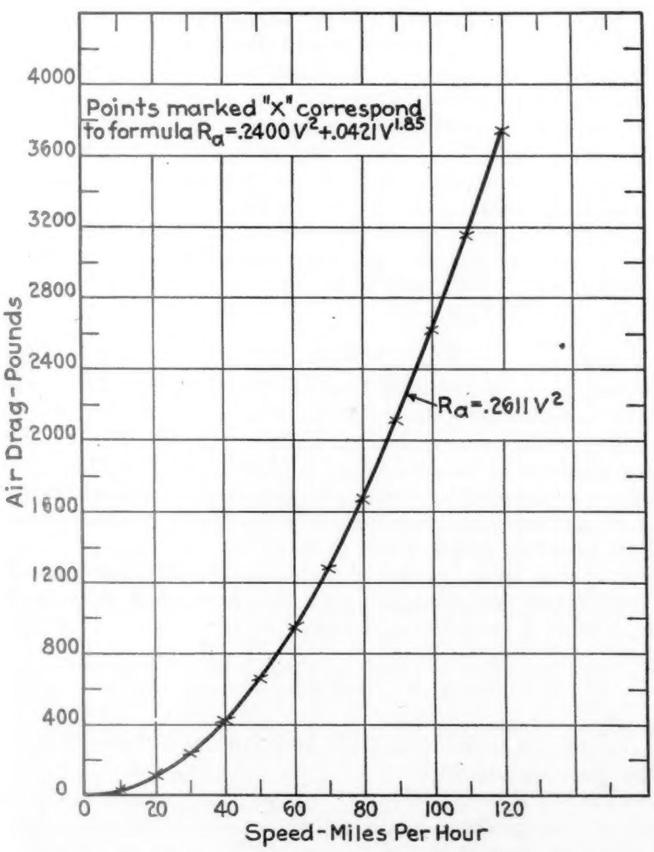


Fig. 2—Comparison of resistance curves from Test No. 28

For example, let us take the net values of air resistances from the model equipment used in Test No. 18, multiply these values by the square of the inverse ratio of the scale, and compare them with the resistances for full-scale equipment given in Table II. This has been done in Table IV, from which it will be observed that the values obtained by multiplying the drag values by the square of the inverse ratio of the scale are greater than the values of R_a obtained by formulas [3] and [4] for corresponding speeds. This is because that portion of the air resistance which is due to skin friction is then multiplied by $16^2 = 256$, while it should be multiplied only by $16^{1.85} = 169$. By using the two-member formula with two different exponents (2 and 1.85) the scale effect was properly corrected, after which the simplification through the one-member formulas was entirely permissible, as this gave practically identical numerical values.

Thus, all two-member formulas of the type

$$R_a = K_pV^2 + K_fV^{1.85} \quad [2]$$

derived from the New York University tests[1] have been converted into one-member V^2 formulas of the form

$$R_a = KV^2 = aAV^2 \quad [7]$$

Coefficients K_p, K_f, K, a, and A for each formula are given in Table I. The maximum errors of this conversion at 30 and 120 m.p.h. are also shown in Table I for each test.

Further Simplifications

After the admissibility of the one-member V^2 formulas had been established for all practical purposes, a further

Table III—Comparison of Air Resistances Obtained by Using Formulas [5] and [6]

Speed, m.p.h.	R_a from formula [5], lb.	R_a from formula [6], lb.	Difference, per cent
10	27	26.1	–3.33
20	107	104.4	–2.39
30	239	234.9	–1.72
40	423	417.8	–1.23
50	659	652.7	–0.96
60	946	940.0	–0.63
70	1,285	1,274.4	–0.83
80	1,676	1,671.0	–0.30
90	2,118	2,114.9	–0.15
100	2,611	2,611.0	0.00
110	3,156	3,159.3	+0.10
120	3,752	3,759.8	+0.21

simplification was found to be possible in evaluating the influence of the length of the train. DeBell and Lipetz in a previous article[3] recommended formulas in which the length of the train was expressed as an exponential term.

For example, the following formulas were established for power-car trains in still air:

For cars with open skirts (18 in. from skirt to top of rail)

$$R_a = 0.00224P_c \, (L/100)^{0.8} \, V^2 + \Sigma KV^2 \quad [8]$$

while for cars with closed skirts (completely under the car), a similar formula was recommended

$$R_a = 0.0020P_c \, (L/100)^{0.8} \, V^2 + \Sigma KV^2 \quad [9]$$

In these formulas P_c = perimeter of car from plane of top of rails over car to plane of top of rails, ft.; L = overall length of train, ft.; V = speed of train, m.p.h. and ΣK = summation of factors ($K_1 + K_2$, etc.) of the various items whose drag depends on dimensions other than perimeter and length. The factors K were given in DeBell and Lipetz's article.[3]

Similar formulas were given in the article[3] for streamlined trains pulled by separate locomotives and nonstreamlined (standard) trains.

The air-resistance coefficients for streamlined trains, using these formulas, are shown in Fig. 3 by dashed lines. It can be easily seen that by replacing the curved portions of the dashed curves by straight lines (the solid curves), the error is very small. Therefore, the author of this article suggested that instead of formula

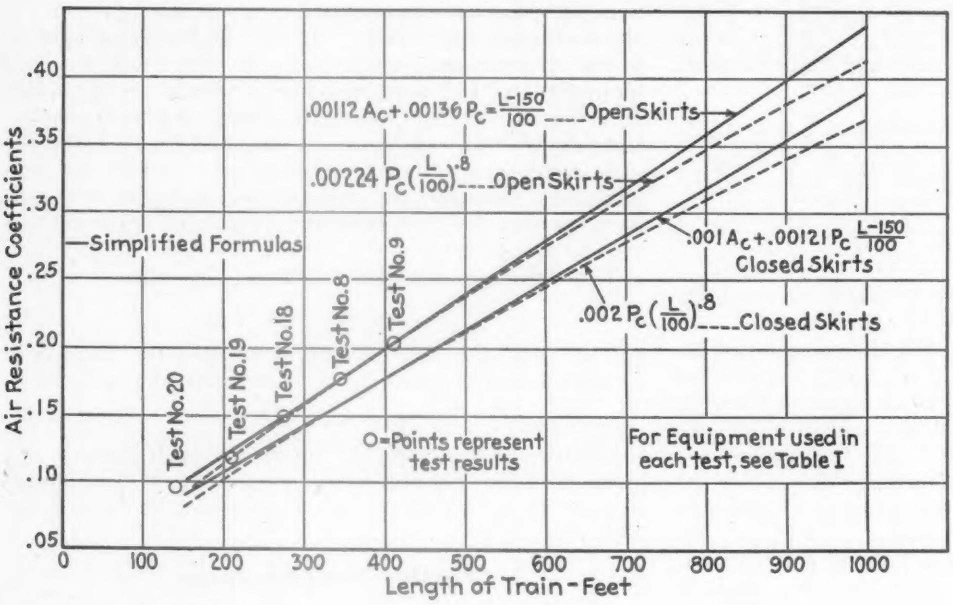


Fig. 3—Air-resistance coefficients of streamline trains

[8] for open skirts, the following formula for fully streamlined power cars with open skirts be used:

$$R_a = (0.00112A_c + 0.00136P_c \frac{L-150}{100} + \Sigma K)\ V^2 \ldots. [10]$$

where A_c = frontal (cross-section) area of the train, sq. ft.; P_c = perimeter of cars from plane of top of rails over car to plane of top of rails on the other side; ft.; L = overall length of train, including the front (power) car, ft.; and V = speed of train, m.p.h. The values of ΣK (K_1, K_2, K_3, etc.) given in DeBell and Lipetz's article[3] remain unchanged.

No drag-test values for trains longer than 410 ft. were observed, and the branch of the exponential curve beyond this length, up to 1,000 ft., was previously obtained by extrapolation. In other words, there is no good reason why the straight-line formula [10] should not be taken as justified by test. Furthermore, the difference between these and the exponential formulas for a train length of 1,000 ft. does not exceed 6 per cent; i.e., the questionable portions of the curves are not worth considering.

Likewise, for closed skirts the coefficients of the formula should be reduced, and the formula will thus be

$$R_a = (0.001A_c + 0.00121P_c \frac{L-150}{100} + \Sigma K)\ V^2 \ldots\ldots [11]$$

The first members of formulas [10] and [11], depending upon A_c, represent the head resistance, while the second members, with P_c, are mainly skin-friction resistances.

As the power car with tail car cannot be much shorter than 150 ft., the formulas can be applied to any power car, rail car, or train. If they are shorter, the numerators in formulas [10] and [11] become negative. This is correct, because the skin friction of the car is less. However, the formulas should not be applied to cars shorter than 100 ft. For such, only the first member, with A_c, should be used.

The streamlined-train tests were made with a power car, tail car and a number of streamlined coaches. For locomotive trains, tests were made with the locomotive and tender, alone, without a tail car, and the locomotive with a tail car, but always without coaches, since streamlined-train data can be used with the resistance of cars in a locomotive train as established by the foregoing formulas.

Regarding streamlined steam locomotives, values of locomotive resistance with different noses, boilers, and shrouds are given in Table I. For practical purposes it is advisable to consider the resistance of the best streamlined locomotive as a basis and correct this figure, as it was done with the cars of the streamlined train, by adding the differences K due to the omission of one or another feature of good streamlining. The lowest resistance was found for the streamlined locomotive with helmet nose, round-top boiler, and long (closed) shroud (test No. 27), namely

$$R_a l = 0.1275 = 0.000924A_L \ldots\ldots\ldots\ldots\ldots [12]$$

where A_L is the frontal area of the streamlined locomotive, which is 137.98 = 138 sq. ft.

Regarding the different corrections K, ΣK is the summations of factors ($K_1 + K_2 +$, etc.) of the various items of which the drag depends on other dimensions than perimeter and lengths. The values of K were given in a previous article.[3]

On the basis of the foregoing, the formula for a streamlined train consisting of cars with open skirts and hauled by a streamlined locomotive is

$$R_a = (0.000924A_L + 0.00136\ P_c \frac{L-100}{100} + \Sigma K)\ V^2 \ldots. [13]$$

If the streamlined cars of the train have closed skirts, the formula should be

$$R_a = (0.000924A_L + 0.00121\ P_c \frac{L-100}{100} + \Sigma K)\ V^2 \ldots. [14]$$

In formulas [13] and [14], A_L is the frontal area of the locomotive. Other notations are the same as before. For coefficient 0.000924 see Table I, Test No. 27.

Similar to what was said regarding formulas [10] and [11], the second members in brackets of formulas [13] and [14] have the subtrahends in the numerators equal to 100, as a round figure, because the length of the tested locomotive and tender was 96 ft., and the error is slight, as compared with what we would have had if the subtrahends were taken equal to 96. If the locomotive is longer, or shorter, the adjustment will be made automatically when the correct length of the locomotive will be included in the total length L of the train.

Irrespective of the subtrahends of the members in the brackets, 100 or 150, the increase of the air-resistance coefficient per 100 ft. of train length is always the same.

For streamlined cars with open skirts the increase is, according to formula [13]

$$0.00136P_c \quad \ldots\ldots\ldots\ldots\ldots\ldots [15]$$

and for streamlined cars with closed skirts, it is

$$0.00121P_c \quad \ldots\ldots\ldots\ldots\ldots\ldots [16]$$

The perimeter of streamlined cars P_c usually varies between 28 ft. 6 in. and 31 ft. 6 in., the average being 30 ft. For our test cars, P_c was 29.33 ft. For open skirts, formula [15] will give at $P_c = 30$, or $0.00136 \times 30 = 0.0408$, and formula [16] will give, for closed skirts, $0.00121 \times 30 = 0.0363$. Thus, a very simple approximate rule can be established for air resistance R_a of streamlined trains. The rule is

$$R_a = KV^2 \quad \ldots\ldots\ldots\ldots\ldots\ldots [17]$$

where K is the general locomotive and train air-resistance coefficient, equal to the sum of K's for locomotive and cars, and V is the speed, m. p. h. For the locomotive, K should be taken from Table I (tests Nos. 21-27), depending upon the nature of streamlining. For every 100 ft. of the length of cars, 0.0408 should be added for open skirts, while 0.0363 should be added for closed skirts.

Table IV—Comparison of Air Resistances Obtained from Formulas [3] and [4] with Those Obtained by Increasing the Resistances of the Model in the Inverse Ratio of the Square of the Model Scale*

1	2	3	4	5	6
Speed m.p.h.	Air resistance of model used in test No. 18, lb.	Inverse of model scale squared	Product of col. 2 and col. 3, lb.	R_a from formula [3], lb.	R_a from formula [4], lb.
30	0.600	256	153.6	142.3	135.3
40	1.122	256	287.2	249.8	240.5
50	1.784	256	456.7	386.6	375.8
60	2.510	256	642.5	552.5	541.1
70	3.502	256	896.5	747.4	736.5

* The equipment for which these values are applicable are given in Table I under test No. 18.

For instance, if we have a train consisting of a locomotive 100 ft. long, with helmet nose, round-top boiler, and short shroud uncovering the drivers, and of four streamlined 70-ft. cars with open side-sill skirts, the coefficient for the whole train K_t, will be (from Test No. 26)

$$K_t = 0.1575 + (0.0408 \times 2.8) = 0.1575 + 0.1142 = 0.2717$$

and the resistance formula of the one-member form is

$$R_a = 0.2717V^2$$

If the locomotive is longer than 100 ft. and a more accurate figure is desired, the excess length should be added to length of the four cars. If there were a bulge between the tender and the first car, or if there were a tail car, corrections K should be added or deducted, as the case may be. No corrections for locomotive noses, boiler tops, or shrouds (K_7, K_8 and K_9) should be made, as this is already taken care of in the K of the locomotive in Table I. If the perimeter of the cars P_c be known, and a more accurate figure were desired, the increase in air-resistance coefficient per each 100 ft. of train length can be taken as $0.00136P_c$, or $0.00121P_c$, for open or closed skirts, respectively. Likewise, if the frontal area of the locomotive A_L be known, instead of K, a should be taken from Table I and the locomotive coefficient should be figured. Also in this case corrections K_7, K_8 and K_9 should be disregarded.

For standard locomotives and trains it was not so easy to find a consistent law, probably for the reason that the gaps between the cars introduce eddies and turbulence which cannot be represented by one formula. Furthermore, it should be said that models of standard equipment, which were used at the tests at New York University,[1] were of two different scales (1/16 and 1/32) and the two-member formulas for these equipments, when expanded to full scale, did not give identical results. This can be seen from Fig. 4, where points representing results of Tests Nos. 28 to 35, inclusive, are shown on a chart drawn to a larger scale.

The method of expanding the test results to full scale, which was so helpful for the study of the test results with streamlined equipment, was inapplicable to standard equipment. The power of 1.85 of the second member in formula [2] probably ought to be increased, coming closer to 2, which represents turbulent air flow better than 1.85. In our standard equipment, which has air gaps, turbulent flow probably predominates, and the extrapolation should be made more in relation to the square of the size S_c^2 than $S_c^{1.85}$.

The curve for the standard cars, shown in Fig. 4, corresponds to a formula

$$K_s = 0.00283P_c \; (L_c/100)^{0.80} \quad \ldots\ldots\ldots\ldots\ldots [18]$$

where P_c, the perimeter of the test cars used, is 37.83 ft.,

(*Continued on page 140*)

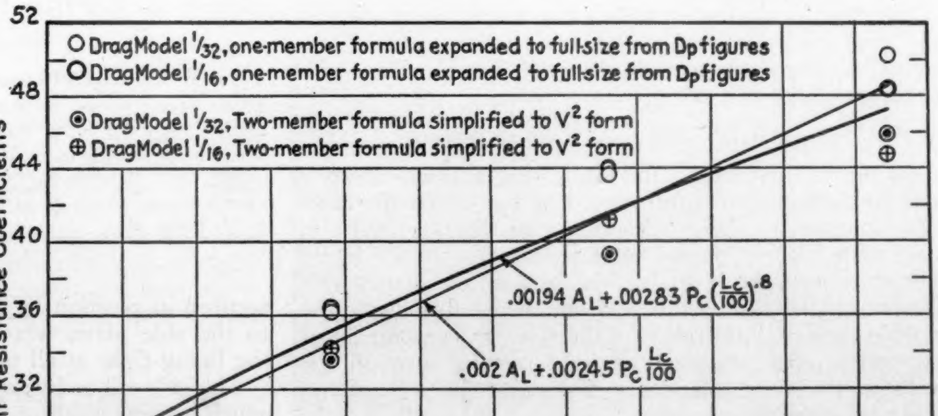


Fig. 4—Air-resistance coefficients of standard trains

D. & H. box cars of 40 tons nominal capacity have a cubical capacity of 3,378 cu. ft., and a load limit of 93,300 lb.

D. & H. Builds Lightweight

Welded Freight Cars

One experimental hopper car and 100 box cars all of 40-tons capacity built partially of alloy steels—Reduction in tare weight increases capacity to that of 50-ton cars—Innovations introduced in the body side construction of the box cars

THE D. & H. recently completed the construction of 100 all-steel box cars of 40 tons nominal capacity and having a cubical capacity of 3,318 cu. ft. Of this order, all of which were built in D. & H. shops and are now in service, 75 are of riveted and welded construction, 10 are of all-welded construction, and 15 are all-welded with the exception of the ends which are only partially welded to the roofs and are riveted to the sides and end sills. The sides for all the cars were prefabricated at the shops of the Greenville Steel Car Company, a subsidiary of the Pittsburgh Forgings Company, and shipped to the D. & H. shops. The doors, with Camel roller lifting fixtures, were supplied by the Youngstown Steel Door Company. Dreadnought steel ends were shipped to the D. & H. shops and welded there, after which all safety appliances were riveted in place. Chicago-Hutchins dry-lading roof sections were also assembled and the cap seams were riveted at the D. & H. shops.

In these cars, high-tensile alloy steels were used in the principal sections of the underframe, which permitted some reduction in tare weight. The principal proportions of the car are given in Table I.

Innovations in Side Construction

In the last five cars some interesting features in body side construction were introduced by the Greenville Steel Car Company. These sides comprise sheets of 0.10-in. steel with channel shaped vertical ends 1¾ in. in depth. The steel posts are ¼-in. by 3-in. by 3-in. tee shapes with flanges on the inside, the web end being flush with the outside sheets. Fabrication of the sides was accomplished by electric spot welding, the weld passing through the webs of the sheet channel sections and the web of the posts between the channels.

Of equal interest is the novel means of applying the inside wood lining in the spaces provided between the flanges of the side-sheet channels and the tee-shaped posts which combine to form grooves or slots into which the lining sections can be easily positioned. The lining, which is tongued and grooved, is 39½ in. long by 1½ in. thick by 3¼ in. wide, this size representing a departure from the conventional full-length pieces. The ends are milled to fit in the grooves previously described. Each piece is applied from the top. Finally, the top piece is secured in position by means of a stud and nut, welded to the side plate, which provides a means for keeping the lining tight at all times; no nails whatever are used.

The side sill is formed in the shape of the letter "W" which permits welding of the posts on the 5⅛- in. vertical section of the side sill. With this type of side, the inside width of the car was increased by 1.825 in.

This side construction was adopted by the D. & H. because (1) it is believed that it possesses adequate strength, (2) it is found that spot welding eliminates to a large degree the buckling of sheets encountered by

Table I—Principal Proportions of 95 of the 40-Ton Box Cars

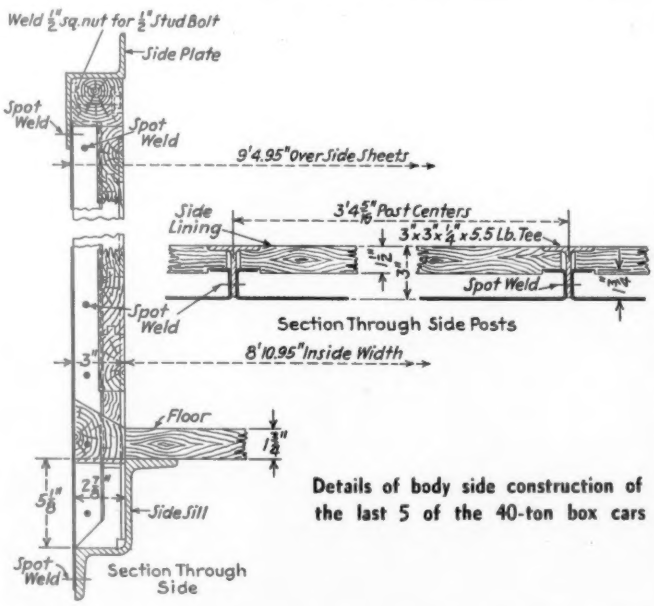
Length inside, ft. and in.	40–6
Length over striking castings, ft. and in.	41–8½
Truck centers, ft. and in.	30–8½
Width inside, ft. and in.	8–9⅛
Height inside at eaves, ft. and in.	9–4¼
Height from rails over running board, ft. and in.	13–9¹¹/₁₆
Capacity, level full at eaves, cu. ft.	3,318
Light weight, lb.	41,000
Ratio of pay load to gross load, per cent	69.8

other methods, (3) by the application of heavier lining, 1½ in. thick, the car is more desirable from a shipper's standpoint as it provides a more solid side for nailing and bracing lading, and (4) the heavier lining will reduce maintenance expense as it will better withstand wear and tear. The principal proportions of the last five cars built are given in Table II.

Other Construction Details

A. A. R. double Z-section center sills of the U. S. S. Man-Ten steel continuously welded at the junction of the two flanges are employed in the construction of all the cars. All bolster webs, crossties, cross-bearer webs and the side sheets are of copper-bearing steel. All other parts are of carbon steel.

The trucks have integral cast-steel side frames for 5-in. by 9-in. journals. The bolsters are cast steel. A. A. R. springs are used with one Frost or Miner truck-spring snubber in each spring group. Truck construction includes Creco four-point brake-beam supports, and A-Zee brake-hanger suspensions. The cars are also equipped with Kass metal brake steps, Ajax



Details of body side construction of the last 5 of the 40-ton box cars

power hand brakes, Miner draft gears, and A. A. R. bottom-operated Type E couplers furnished by the National Malleable and Steel Castings Company and fitted with Union Metal Products centering devices. All cars are equipped with type AB brakes.

The interior of the cars are wood lined, with the exception of the roof; however, before the cars were lined, a heavy coat of Continental cement was applied for a height of 2 ft. on the ends and sides of the interior. After lining, the wood was sand papered and the sides sprayed with a coat of enamel and the floor sprayed with Balcolac. The outside of the roof was sprayed with two coats of Valdura after the inside and outside of the roof had been sprayed with one coat of galvanized-iron primer. All painting, including stenciling, was done by the spray method.

Experimental 40-ton All-Welded Hopper Car

The D. & H. has had in service for a little more than a year an experimental all-welded self-clearing hopper car of 40-ton nominal capacity and with a tare weight of 32,700 lb. This light weight was secured by welded construction, the use of lightweight alloy steels, and unusual design features as well as the use of integral-type cast-steel trucks with 5-in. by 9-in. journals. The capacity of the car is 1,752 cu. ft. when level full at the side sheets and 1,981 cu. ft. when loaded with a 10-in. uniform heap of coal. Although the car is stenciled 80,000 lb. capacity, it is capable of carrying 103,300 lb., this being the weight after 32,700 lb., the tare weight, is deducted from 136,000 lb., the A. A. R. permissible total

Table II—Principal Proportions of the last 5 of the 40-ton Box Cars

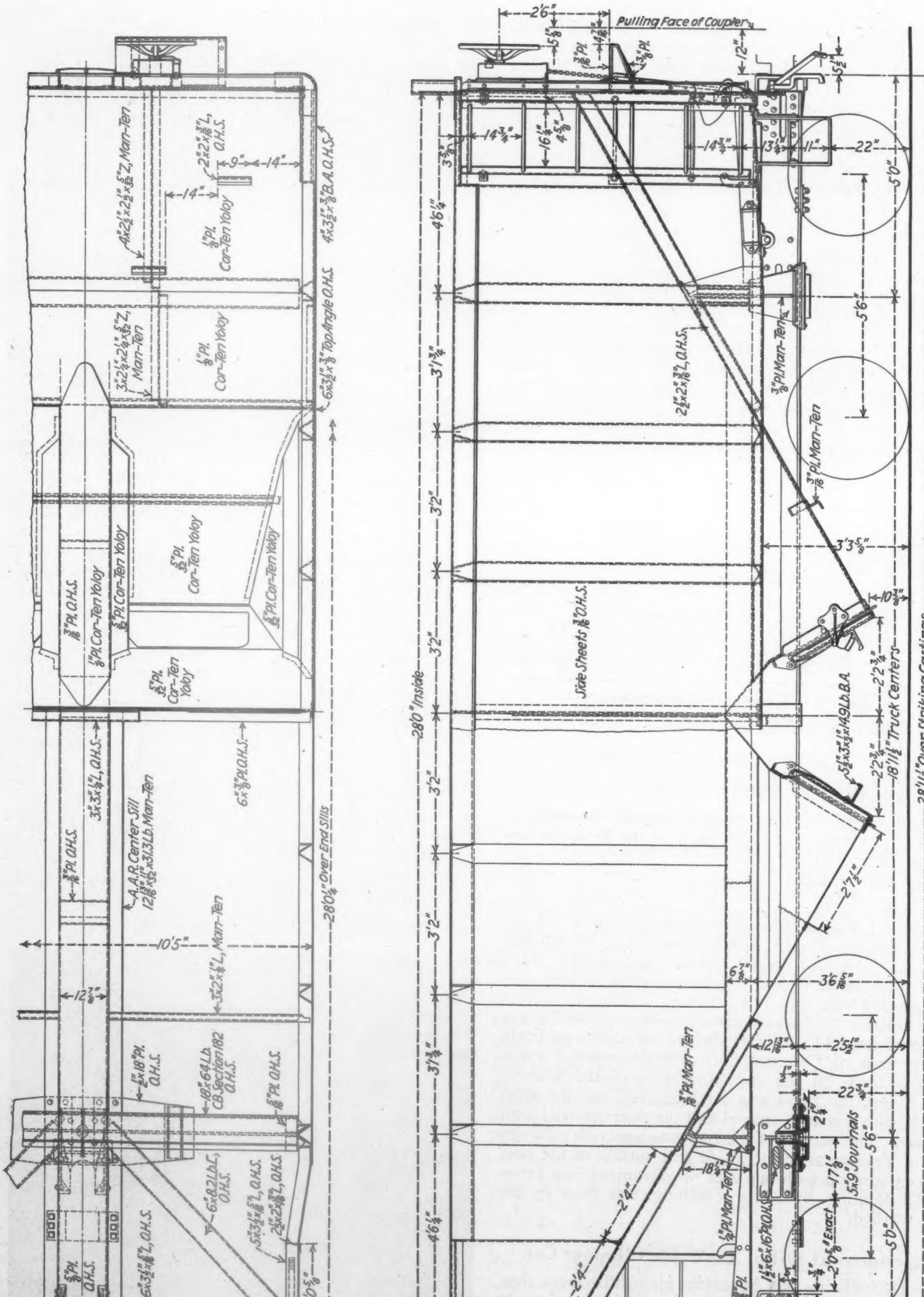
Length inside, ft. and in.	40– 6
Length over striking castings, ft. and in.	41– 8½
Truck centers, ft. and in.	30– 8½
Width inside, ft. and in.	8–10.95
Height inside at eaves, ft. and in.	9– 4¼
Height from rails over running board, ft. and in.	13– 9 11/16
Capacity, level full at eaves, cu. ft.	3,378
Light weight, lb.	42,700
Ratio of pay load to gross load, per cent	68.6

weight on the rails for a car with 5-in. by 9-in. journals. However, when carrying anthracite coal, the service for which the car was designed, it will carry a maximum load of 103,012 lb. when heap loaded to 1,981 cu. ft. Loaded thus with anthracite coal the car weighs 288 lb. less than the permissible load limit. Thus, by reducing the tare weight of the car with this cubical capacity, a maximum load of over 50 tons has been attained—a ratio of pay load to gross load of 75.9 per cent. The ratio of pay load to tare weight is 3.17 to 1. The design of the car is experimental, but its performance to date has proved its serviceability with the result that the D. & H. will probably adopt its design as standard for future construction of similar cars.

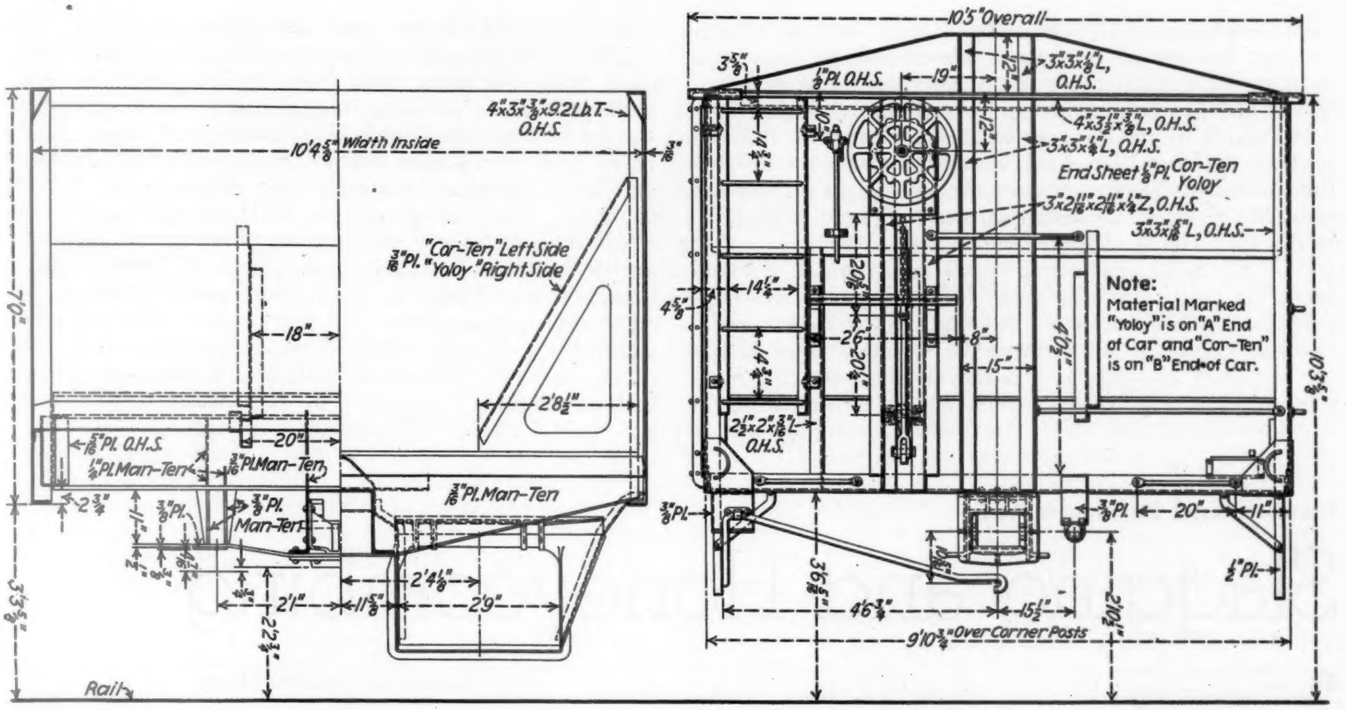
The reduction in tare weight was made possible through the use of alloy steels, welding fabrication instead of riveting, and unusual design features. One of these features is the elimination of the usual type of body bolster which is replaced by an 18-in. I-beam weighing 31.3 lb. per ft. placed on top of the center sills. Side-bearing supports built up of U. S. S. Man-Ten steel plates are welded to this I-beam and are braced from the bottom of the center sill; the bearing surface is composed of a ⅜-in. spring-steel plate. The top flange of the I-beam is bent close to the web to an angle of 30 deg. to act as the main support of the end slope sheets.

Another feature of the design is the inside integral V-shaped side posts. The V is formed at one end of each side sheet. The end of the adjoining sheet overlaps

The lining of the cars is made up of tongued-and-grooved pieces 39½ in. long, 3¼ in. wide and 1½ in. thick—No nails are used to secure the lining



Side elevation and plan view of the D. & H. experimental 40-ton hopper car



End elevation and cross-sectional view of the D. & H. 40-ton hopper car

the open side of the V, and when the sides were welded along both edges of the V a closed triangular-section post is formed.

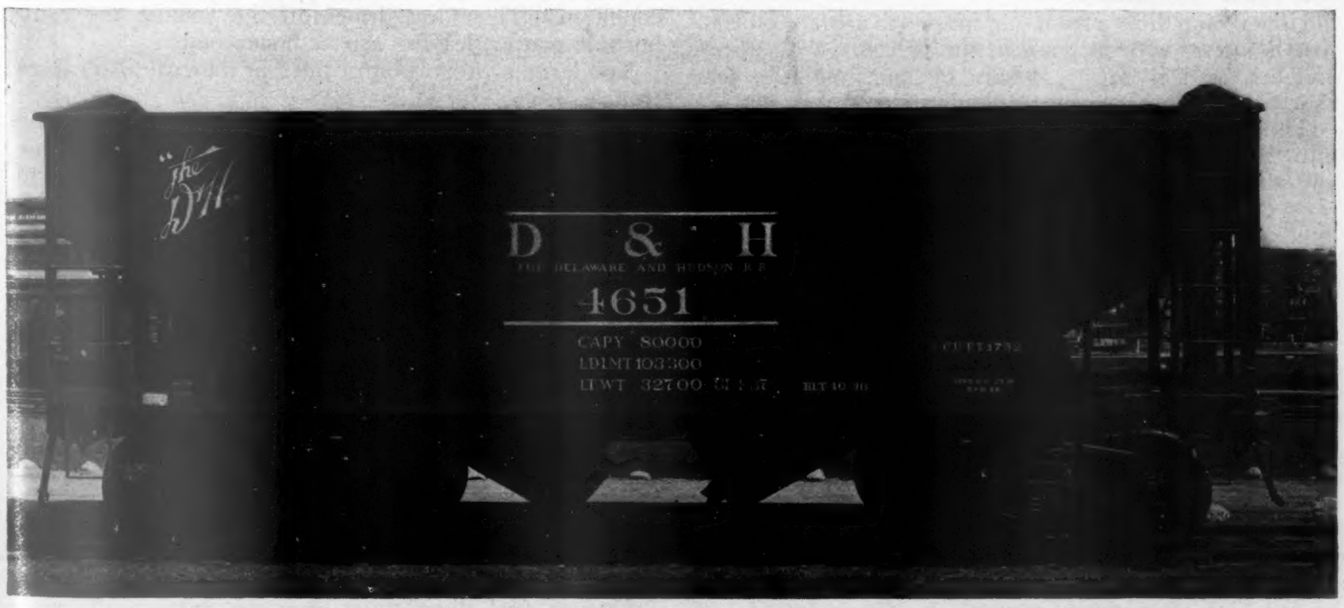
The center sills are formed of two A. A. R. Z-sections of U. S. S. Man-Ten steel joined by continuous welding at the junction of the two flanges. The body-bolster parts, cross bearers and floor stiffeners are also of the same material electrically welded. The slope and hopper sheets at the A end of the car are of Yoloy steel while those at the B end are of U. S. S. Cor-Ten steel. The side sheets, however, are of conventional carbon steel.

Table III—Principal Proportions of the 40-Ton Hopper Car

Length inside, ft. and in.	28– 0
Length over striking castings, ft. and in.	28–11½
Truck centers, ft. and in.	18–11½
Width inside, ft. and in.	10– 4⅝
Height from rails at side sheets, ft. and in.	10– 3⅝
Capacity, level full at side sheets, cu. ft.	1,752
Capacity, with 10-in. uniform heap load, cu. ft.	1,981
Light weight, lb.	32,700
Ratio of pay load to gross load, per cent	75.9

It has been the experience of the D. & H. that the side sheets of all-steel hopper cars have an average life of 17 years, whereas the slope and hopper sheets last about 12 years. From a car maintenance point of view it would be ideal to renew these major parts at one shopping, and therefore one of the objectives sought with this car is to extend the life of the parts that failed in 12 years and establish a comparable service life for all major sections. In furtherance of that end, the hopper unit is strengthened by the application of Wine cast-steel hopper frames, cast-steel doors and door locks.

Other items of interest on this car are the AB type



All-welded hopper car of 40 tons nominal capacity with a load limit of 103,300 lb. and a weight of 32,700 lb.

brake equipment and Ajax power hand brakes. A significant feature of the car is the relatively few parts used in its construction; there are only 1,153 parts, of which 601 are bolts, nuts and rivets, as compared with 3,596 parts in the conventional hopper car of this capacity. The use of welded, instead of riveted, construction is responsible for most of the saving since there are only 277 rivets in the entire car as compared with 2,576 in the U. S. R. A. 55-ton hopper car.

The D. & H. has experienced considerable demand from the anthracite coal fields for a car with twin hoppers having a capacity of 50 tons. This experimental car has therefore been favorably received since it has the required capacity and is entirely self-clearing with the hopper spacing so arranged as to effect unloading in one spotting of the car. The principal proportions of this all-welded hopper car are given in Table III.

The truck side frames were furnished by the Adirondack Steel Company with 5-in. by 9-in. journals and, with journal boxes cast integral, there is a saving in weight as compared with side frames and larger journals. The wheels are 750-lb. chilled-iron single-plate, A. A. R. standard made by the Albany Car Wheel Company. The springs are A. A. R. standard with one Frost friction unit in each spring group. Truck bolsters are of cast steel. Truck brake rigging, brake beams, brake shoes, hangers and other parts conform to A. A. R. specifications. The car is also equipped with metal brake steps, Miner draft gears, and alloy-steel A. A. R. Type E couplers with 6¼ in. by 8-in. shank, bottom operated, furnished by the National Malleable and Steel Castings Company.

Causes and Remedies of

Slagging and Honeycombing

One problem which has come before the Railroad Smoke Association of Hudson County, N. J., persistently at its monthly meetings, has been that of the formation of slag and honeycomb. Eventually it was decided to appoint a special committee to make a thorough study of it. The report of this committee was made at the February meeting of the Association, together with a minority report by William G. Christy, which does not take issue with the majority report, but, rather, amplifies certain features in it.

The report opens with certain general observations and then, under various heads, discusses the causes and remedies for slagging and honeycombing. The two reports, somewhat abridged and rearranged, follow:

Majority Report

Slag contains iron in some form combined with a percentage of silicon and ash. The formation of slag is developed by any condition that retards combustion, causing temperature changes which will not produce enough heat to convert the mineral particles of fuel into non-fusible substances.

Honeycomb differs from slag inasmuch as the iron content is lower, with increase in the percentage of silicon and ash, and is caused chiefly by any condition that shortens the time element of combustion.

The fusing point of ash and clinker may be divided into three stages—the initial point, the softening point, and the fluid point. The temperature range depends upon the constituents and may cover from fifty to several hundred degrees F. for any given fuel, and ranges from perhaps 1,800 to 3,000 deg. F. for different fuels. Any decrease in temperature after fluidity has been attained will naturally tend to affect the density and hardness of the clinker form.

The rate of burning has a definite bearing on the percentage of clinker formation in the ash. The highest percentage of clinker formation was found by Fieldner, Selvig and Nicholls, to occur at a rate of burning of 20 to 30 lb. per sq. ft. per hour. The quantity of clinker decreases as the rate of burning increases, although density and fusion are greater at higher rates. The rate of decrease of quantity of clinker becomes less for low ash fusion temperature. Escape of gases through prolonged high temperature permits the formation of less brittle clinker.

Design of Locomotive

Each class of locomotive is designed for a predetermined rate of work, and the proportions between heating surface, grate area and flue area must be governed by the class of service. When this rate of work is exceeded, the fuel bed is disturbed by the increase in draft and supply of oxygen to the fuel bed. When this occurs, small particles of plastic ash are picked up by the flow of gases and adhere to metal surfaces, causing slag formations.

Remedy: Do not load the locomotive above its rated capacity.

Coal

The presence of iron in pyritic form or lime, in sufficient quantity, causes honeycombing or slag. Coals with high iron content and low fusion point present the greatest problem. Pyritic iron undergoes a chemical change at 800 to 900 deg. F., becoming ferrous sulphide. It adheres to small pieces of unburned fuel and is carried along by the draft, being thrown against the surface of the staybolt heads and flue sheets in this semi-pasty condition. Then heat drives off the volatile and combustible matter, leaving ash as honeycomb.

Too large a proportion of fines in the coal also causes trouble.

High percentages of iron or lime in the coal cause low melting points (1,800 deg. to 2,000 deg. F.), while alumina and silica raise the melting point from 2,600 to 3,000 deg. F. (Ref.—Kent, Vol. 2, 11th edition). High silica and alumina ash are not readily fusible, and usually ash low in iron and lime has high silica and alumina. Coals high in sulphur will generally clinker readily. Ref.—Transactions, A. S. M. E., FSP-50-60, 1928. Fieldner, Selvig, and Nicholls.)

Remedies: Give special attention to selection of fuel, watching out for pyritic content. Select coal with minimum amount of sulphur and iron pyrites. Wet down fine coal. Select coals which will meet the requirements of the service, will be within certain prescribed limits, and will have uniform quality.

Firing of Locomotive

Uneven fuel distribution over the grates will cause thin spots or holes. The rate of combustion increases at

these spots, the temperature rises, and the increase in the velocity of the gases in such locations picks up small particles of plastic ash which deposit on the metal surface and multiply into slag formations. Other causes of slag and honeycombing are banking back corners; forcing fires, thus shortening the time element of combustion; heavy firing, and high rate of combustion per square foot of grate area.

Remedies: Follow good firing practices; distribute coal evenly to the fuel bed; maintain a uniform thickness of fuel bed; avoid banking; avoid heavy firing. In general, a clean, bright, level fire, as thin as possible, over the entire grate level, is at all times the most economical and will assist in reducing slag formations to a minimum.

Operation of Locomotive

Several factors in locomotive operation are responsible for slag and honeycombing. Among them are slipping of drivers, which increases the velocity of the gases and shortens the time of combustion; foaming or priming which increases weight of exhaust steam; abnormal high water conditions; improper operation of throttle, reverse gear, boiler feed, etc.

Remedies: Watch the water level; avoid sudden opening of throttle and slipping; when foaming or priming occurs, follow railroad company's instructions; assure lubrication of valves, cylinders, pumps, etc.; enginemen and firemen must work together to produce results, conserve coal and reduce smoke.

Drafting of Locomotive

Causes of difficulty are restricted air space in the ash pan; excess openings in the grates; smokebox leaks, and holes in or misalinement of stack, draft pipe, exhaust nozzle and netting. An improperly drafted locomotive will cause slag formation.

Remedies: Avoid loose fitting or broken valve rings and piston rings, both of which impair front-end vacuum. The exhaust nozzle plays an important part in the operation of the locomotive. Its size is usually specified in the design. Tests should be made by the responsible department under varying loads and when the proper size is determined, all locomotives of a class should be equipped with the same size nozzle and no changes in size made without proper authority. The design of lift pipe and stack should be such that the exhaust will fill the stack and produce proper vacuum to obtain a uniform flow of gases through the tubes.

Maintenance of Locomotive

Causes of slag and honeycombing are leaky superheater units; leaks in the firebox or flue ends; plugged flues; heavy or rough beads on flues; mud and scale in the boilers; condition of the brick arch; defective grates. The maintenance forces play a large part in reducing slag formation. Improper maintenance can be responsible for honeycomb and slag formations.

Remedies: The locomotive must be properly prepared; keep the firebox or front end in proper condition; avoid smokebox leaks; clean flues periodically; replace defective grates; check alinement of stoker distributor plates and stoker jets.

The maintenance forces should see that no firebox leaks exist, that flues are clean and in proper condition, that the smokebox is free of air leaks, and that the exhaust pot base is in line and properly fastened.

A proper schedule of work covering all parts at the boiler-wash period will keep the locomotive in condition through its life between class repair periods, and reduce the daily maintenance. Experience has demonstrated that this method of repairs, and the assignment of locomotives to individual enginehouses for periodic work, reduces delays and trouble from slag formation.

The report was signed by C. K. Keiser, assistant superintendent motive power, Pennsylvania; G. W. Rink, mechanical engineer, Reading Company; T J. McDermott, mechanical engineer, D. L. & W.; E. H. Fezandie, professor of mechanical engineering, Stevens Institute of Technology; and William G. Christy, smoke abatement engineer, Hudson County.

Minority Report

William G. Christy, smoke abatement engineer, Hudson County, made a supplemental report from which the following extracts are taken.

Water treatment results in much cleaner boiler conditions and a decided decrease in boiler maintenance work. The use of feedwater as free as possible from scale forming elements, should be a contributing factor in keeping down slag and honeycomb.

At our June meeting, Henry Kreisinger, Combustion Engineering Company, made the following statement: "Building the fuel bed wrong and starting it wrong, is probably a great factor in making the tube sheet slag." Certainly, if the fire is not started properly, and the fuel bed built up correctly in the beginning, it is naturally more difficult to get the fire in the proper condition. It would appear that if we start with fuel bed conditions right, this will help in eliminating the trouble with slag and honeycomb.

At the May meeting, W. L. Gorton, fuel supervisor of the Erie, put this down as one of the causes: "Running engines too far without dumping for cleaning out, especially when using coal of high sulphur content." I do not know how big a factor this is, but it seems to me it should be mentioned.

The question of sealed or unsealed arches has been discussed at length. We all know there is a difference of opinion as to just which is the best type of arch. It seems to me that the majority of the opinions expressed showed that there was less trouble with flues plugging up when there were at least some openings at the bottom of the arch. If we can keep the flues from plugging, this should certainly be one way to help in preventing slag formation.

In extensive investigations Henry Kreisinger has found that particles of unburned or partly burned coal are carried along with the gases, together with sticky ash, and are deposited on the flue sheets or tubes. These particles continue to burn after they are deposited and for a short time the temperature actually increases. This, undoubtedly, makes the slag condition worse. To my mind, poor combustion, or incomplete combustion, is one of the causes of our trouble. Anything we can do to get better, or more complete combustion, will be of material help.

The CO_2 which goes up to about 12 per cent in its passage through the fuel bed is reduced to 8 per cent when the top of the fuel bed is reached. Theoretically, it should increase to 16 or 17 per cent (ideal conditions), but instead, it is reduced. Coming off the top of the fuel bed we have unburned gases principally in the form of CO and methane. We must have oxygen to burn these gases. This means getting air over the fire in some manner. To do this properly in a locomotive, we may have to redesign the firebox. We must never lose sight of the fact that both turbulence and oxygen are two of the very essential elements of complete combustion. To get turbulence, we need air at high velocity over the fire. All modern stoker installations in stationary plants have over-fire air provided.

According to Mr. Kreisinger, the gases coming off the

top of the fuel bed contain something like 15 to 17 per cent of combustible gases. This is true, regardless of the thickness of the fuel bed and regardless of the rate of burning coal. Tests at the Bureau of Mines were made at fuel burning rates varying from 3 lb. to 185 lb. of coal per sq. ft. of grate per hour. When you try to force more air through the fuel bed, instead of getting 14 or 15 per cent CO_2 and no combustible gases at the top of the fuel bed, the rate of combustion, or the rate of burning the fuel, is just increased. The percentages of CO_2 and unburned gases remain about the same. This is something to which we should give serious consideration.

C. M. St. P. & P. 4-8-4 Freight Locomotives

(*Continued from page 128*)

Low water alarm	Barco Manufacturing Co., Chicago
Steam-heat gage	Ashton Valve Co., Boston, Mass.
Steam-heat stop valve; steam-heat reducing valve	Vapor Car Heating Co., Inc., Chicago
Typhon horn	The Leslie Co., Lyndhurst, N. J.
Chime whistle	Locomotive Equipment Division of Manning, Maxwell & Moore, Inc., Bridgeport, Conn.
Bell ringer, King type	U. S. Metallic Packing Co., Philadelphia, Pa.
Cab signals with air whistle	Union Switch & Signal Co., Swissvale, Pa.
Sanders	Morris B. Brewster Company, Chicago
Coal sprinkler hose	Gustin-Bacon Mfg. Co., Kansas City, Mo.
Fuel sprinkler	Locomotive Equipment Division of Manning, Maxwell & Moore, Inc., Bridgeport, Conn.
Headlight; generator, Type E-3-LA	Pyle-National Co., Chicago
Cylinder cocks	T-Z Railway Equipment Co., Chicago
Cylinder and steam chest bushings; valve bull rings and sectional combination iron and bronze packing rings	Hunt-Spiller Manufacturing Corporation Boston, Mass.
Piston rods	Standard Steel Works Co., Burnham, Pa.
Piston-rod and valve-stem packing, Diamond Crescent	T-Z Railway Equipment Co., Chicago
Piston bull rings and combination iron and bronze packing rings; outer rod bushings	Hunt-Spiller Manufacturing Corporation Boston, Mass.
Reverse gear	(15) The Baldwin Locomotive Works, Philadelphia, Pa.
	(15) American Locomotive Co., New York
Engine bed	General Steel Castings Corp., Eddystone, Pa.
Crank pins	Standard Steel Works Co., Burnham, Pa.
Engine truck and trailer wheels	American Steel Foundries, Chicago
	Standard Steel Works Co., Burnham, Pa.
Driving-wheel centers; Boxpok; driving axles; front engine-truck axles	Standard Steel Works Co., Burnham, Pa.
Engine truck (inside bearings)	General Steel Castings Corp., Eddystone, Pa.
Roller bearings	The Timken Roller Bearing Company, Canton, Ohio
Roller-bearing units	American Steel Foundries, Chicago
Trailer truck, Four-wheel Delta	General Steel Castings Corp., Eddystone, Pa.
Trailer tires	American Locomotive Co., Railway Steel Spring Div., New York
Springs, engine and coil	American Locomotive Co., Railway Steel Spring Div., New York
Brake, No. 8ET	Westinghouse Air Brake Co., Wilmerding, Pa.
Lateral motion device; Slid-Guide attachment	American Locomotive Company, New York
Unit Safety drawbar and Type E-2 radial buffer	Franklin Railway Supply Co., Inc., New York
Lubricators:	
Left side, unlagged	(15) Detroit Lubricator Co., Detroit, Mich.
	(15) Ohio Injector Co., Wadsworth, Ohio
Right side, lagged	(30) Nathan Manufacturing Co., New York
Lubrication	Alemite Div. Stewart-Warner Corp., Chicago
Lubricator, flange	Morris B. Brewster Company, Chicago
Force-feed pump lubricators	Westinghouse Air Brake Co., Wilmerding, Pa.
Air pump line and generator supply and operating valves	Walworth Company, New York
Flexible metallic conduit between engine and tender	Barco Manufacturing Co., Chicago, Ill.
Tender:	
Rectangular water bottom	General Steel Castings Corp., Eddystone, Pa.
Truck frames	General Steel Castings Corp., Eddystone, Pa.
Wheels	(16) American Steel Foundries, Chicago
	(14) Standard Steel Works Co., Burnham, Pa.
Axles	Standard Steel Works Co., Burnham, Pa.
Roller-bearing units	American Steel Foundries, Chicago
Roller bearings	SKF Industries, Philadelphia, Pa.
Journal boxes	National Malleable and Steel Castings Co., Cleveland, Ohio
Springs	American Locomotive Co., Railway Steel Spring Div., New York
Side bearings	A. Stucki Co., Pittsburgh, Pa.
Coupler, A. A. R.	Buckeye Steel Castings Co., Columbus, Ohio
Uncoupling rigging, Imperial type B	Union Metal Products Co., Chicago
Draft gear	W. H. Miner, Inc., Chicago
Simplex unit cylinder clasp brake	American Steel Foundries, Chicago
Tank steel	Bethlehem Steel Co., Bethlehem, Pa.
Tank valves, tank hose coupler and strainer	T-Z Railway Equipment Co., Chicago
Tank hose	Hewitt Rubber Corp., Buffalo, N. Y.
Tank drain plugs	The Prime Manufacturing Co., Milwaukee, Wis.
Water-level indicator	Locomotive Equipment Division of Manning, Maxwell & Moore, Inc., Bridgeport, Conn.
Back-up lamp	Pyle-National Co., Chicago

Air Resistance Of Trains

(*Continued from page 133*)

and L_c is the length of the car portion of the train.

It is evident from Fig. 4 that a straight line corresponding to a formula

$$K_c = 0.00245P_c\,(L_c/100) \qquad [19]$$

would still be within the region of the quadruple points and, according to what was stated previously, could be justified as a coefficient for standard-car resistance.

Regarding the intersection of both the curve and straight line with the vertical ordinate line corresponding to zero length of cars, the first, for locomotive and tender alone, is $K_L = 0.266$, corresponding to $a = 0.00194$, and the second to $K_L = 0.274$, corresponding to $a = 0.002$, which is very close to the foregoing and is exactly the coefficient given by Cole in the Locomotive Handbook.[5] Thus, for standard locomotive and standard cars, the simplified formula

$$K = 0.002A_L + 0.00245P_c\,(L/100) \qquad [20]$$

can be applied, where A_L = frontal area of the locomotive, sq. ft.; P_c = perimeter of the car from plane of top of rails over car to plane of rails on the other side of the track, ft.; and L_c = length of the car portion of the train, ft.

Therefore, the simplified formula for the air resistance of the standard train is

$$R_a = [0.002A_L + 0.00245P_c\,(L_c/100)]\,V^2 \qquad [21]$$

In the opinion of the author formulas [20] and [21] have the same justification as the formulas which include exponential values of L, but he would not recommend the extrapolation for longer standard trains of either of the two until further wind-tunnel tests or data from actual tests are available. Formulas [20] and [21] have the advantages of being simpler, and in the light of the foregoing speculations, these two formulas should be given preference. Formulas [10], [11], [13], [14] and [21] are recommended by the author for air resistance of streamlined, power car, and locomotive-driven trains, and trains of standard cars driven by standard locomotives.

[5] "Locomotive Handbook," American Locomotive Company, New York, N. Y., 1917, p. 20.

EDITORIALS

Lightweight Driving Parts Needed

In a paper discussing the general subject of rail damage and the relation of locomotives thereto, D. S. Ellis, chief mechanical officer, Chesapeake & Ohio, said at the March meeting of the Western Railway Club that, with modern high operating speeds, particular attention must be paid to locomotive design details to minimize dynamic augment as affected by the following factors: (1) Underbalanced reciprocating weight; (2) unbalanced revolving weight; (3) couples produced by piston thrust on the crank pins and by lateral differences in the vertical planes of reciprocating weights and their counterbalances in the wheels; (4) variations in wheel loads due to static weight, spring deflection with consequent load transfer, center of gravity, and rail elevation.

As regards the possibility of reducing the weight of reciprocating parts by the use of high-tensile alloy steel vs. plain carbon steel, Mr. Ellis quoted figures for two different classes of 4-4-4 type locomotives in which the reciprocating weights were reduced from 870 lb. to 798 lb., or 8.3 per cent, for one locomotive, and from 1,090 lb. to 1,003 lb., or roughly 8.0 per cent for the other locomotive. The corresponding reductions in dynamic augment were 7.7 per cent for one locomotive, and 10.9 per cent for the other. Mr. Ellis strongly urged the instruction of mechanical-department supervisors and mechanics in the proper use and treatment of the alloy-steel locomotive motion work parts if satisfactory results are to be secured.

Fewer Car Loads Transferred at Chicago

What can be accomplished through co-ordinated efforts in solving a more or less difficult problem is well illustrated by the results attained in reducing the number of freight-car loads transferred in the Chicago district due to defective equipment. In 1924, almost 12,000 car-load shipments were transferred at this terminal on account of being loaded in equipment which was unfit to run. At an estimated transfer cost of $25 per car, exclusive of claims, this represented a loss of practically $300,000. An intensive drive, sponsored by the Chicago Car Interchange Bureau, brought both shippers and railroad car inspectors to realize the seriousness of this loss, and the number of car loads transferred was gradually reduced, year by year, until a record was reached of only 52 cars in 1935, this number subsequently increasing to 104 cars in 1936 and 108 cars in 1937. In the latter two years adjustments of loads on open-top cars on account of non-compliance with A. A. R. loading rules increased from 377 to 616.

One of the most effective remedies adopted to reduce load transfers was the development of mobile repair units which enabled the Chicago bureau to make load adjustments without necessitating the handling of defective cars to the repair tracks. The desirability of further extension of this work and also educational efforts among shippers and car inspectors is shown by the slight increase in load transfers and adjustments in 1936 and 1937, an increase which is only partly chargeable to the increased number of revenue cars handled through the terminal. Since the total cost of transferring cars includes not only a direct average labor charge of approximately $25 per car, but extensive damage claims due to the extra handling of materials, delays of 12 to 36 hrs. in reaching the market, etc., it is evident that too much care cannot be exercised in making sure that, so far as possible, every car loaded is in suitable condition to proceed to destination and that the shipment is loaded in strict accordance with the A. A. R. rules.

Inadequate Enginehouses Hamper Operation

Modern motive power with all of its refinements is relatively expensive to buy and, to secure a maximum return on the investment, requires a high continuity of service and minimum time away from its regular assignment. A large percentage of locomotive out-of-service time is chargeable to conditioning operations at engine terminals and, regarding this phase of locomotive maintenance, W. J. O'Neill, superintendent of motive power, Western Pacific, recently made some pertinent comments.

In a paper before the November meeting of the Pacific Railway Club, Mr. O'Neill said: "Speaking of maintenance, mechanical forces have handled and are still handling modern locomotives in enginehouses that were built for smaller power. Stalls and pits are too short; doors cannot be closed because tanks extend out over the pits; and, in order to drop driving wheels, the tenders must be cut off so as not to block the track on each side. Stalls and pits of the proper length, drop pits or drop tables for engine-truck, driver, trailer and tender-truck wheels should all be considered, including suitable shop equipment and machine tools to handle

all kinds of enginehouse repairs. Railroads should consider these as they do laying heavier rails, enlarging tunnels, strengthening bridges, ballasting track, and providing longer and larger tables."

In further emphasizing the need for adequate drop pits, Mr. O'Neill said: "Enginehouses that have Whiting drop pits, or hoists, or other similar devices of modern construction are very fortunate. These greatly facilitate dropping all locomotive wheels. Railroad executives must listen to the pleas of their enginehouse foremen for modern enginehouse facilities and grant the expenditures necessary for these, otherwise locomotives cannot earn a fair return on the investment due to the fact that they are off duty too much of the time while antiquated enginehouse equipment is being used to condition them for further service."

While many intermediate enginehouses have been closed and marked improvements effected at certain others, a large number are still quite inadequate to condition and turn modern motive power with the promptness essential to efficient operation. The question may be asked: Why are not necessary improvements made? The presiding officer at the meeting referred to said that this question reminded him of one once put to a candidate for a job as policeman. In the oral examination given this Irishman, he was asked, "What are rabies and what can be done about it?" to which he replied "Rabies are Jewish priests and nothing can be done about it."

In the present state of railway finances, it is largely true that "Nothing can be done about it," except possibly to study conditions thoroughly and develop careful estimates of cost savings which can be effected by the installation of improved enginehouse facilities and equipment when business conditions improve. In the meantime, enginehouse forces, including both supervisors and workmen will continue as they have in the past to exercise notable ingenuity, resourcefulness and good mechanical judgment in getting the best results with enginehouse facilities available.

The Payroll Distribution

Comment is occasionally heard from railway employees, in the ranks of the mechanical department and elsewhere, indicating resentment at the fact that some railway officers have been paid salaries as high as $100,000 per year. Such comments imply that, if the executives were paid only what they were worth and all of the other employees were paid what they actually earned, the railroads would be much better off and presumably so would the employees.

The question of the fairness of the distribution of compensation among railway employees for their labor is not one which can be discussed in absolute terms; it can be discussed only in relative terms. There is no basis on which to determine positively just how much a railway executive of wisdom and ability may be worth to the owners of the property which he manages, to its employees and to the public which it serves. It hardly seems probable that any specific figure, either below or above $100,000 per year, can arbitrarily be set as marking the limit beyond which, under all circumstances, a corporation will be paying more than the right man in the right place is worth.

But it is not the purpose of this discussion to consider that point. It is proposed here to bring out certain facts which, from the standpoint of the greater proportion of railway employees, are more pertinent in relation to the dissatisfaction many of them from time to time feel with their lot. The first fact is that the question of what should constitute the limit of executive salaries is of purely academic interest. On August 1, 1937, an increase in pay amounting to five cents an hour became effective for approximately 800,000 non-operating railroad employees. This has been estimated to involve an additional payment of $98,000,000 a year in wages to those employees—an average of about $120 to $125 a year per person.

It would be extremely difficult, if not impossible, to determine statistically how much could be saved if the salaries of all executive officers were limited to any specific figures. Let us assume, therefore, that the railroads were to dismiss all of their executive officers (those whose salaries are charged to general expense), including presidents, some vice-presidents, the accounting officers and corporate officers, so that their complete salaries and expenses were available for other purposes, and then let us assume that the amount thus saved were to be distributed among the 800,000 non-operating employees. Each of these employees would receive a further increase of $19 per year, or $1.58 per month. It is obvious that an even more insignificant amount would be involved if there were available only the amount of "excessive" salary received by the higher-paid executives, no matter how the term "excessive" might be defined.

As a practical matter, therefore, employees among the 800,000 who are dissatisfied with their lot will have to look elsewhere than to the "excessive" compensation of railway executives as a possible source of wage readjustment. On October 1, 1937, an increase in pay of 6.6 per cent became effective for the train-service employees. For the 254,000 employees in these groups the amount of this increase was estimated at about $35,000,000 per year, or an average of $135 to $140 per year per person.

But during the past five or six years the road-service groups have, in effect, already acquired a gradual increase in compensation as the result of the growing spread between the time for which they are paid and the actual time worked. For 1937 this spread amounts to one-third in the average rate per hour of all road-service trainmen and enginemen. This leaves out of con-

sideration all compensation for overtime and constructive allowances. Thus, road passenger conductors, whose rate for the straight time paid for averaged 97 cents per hour during 1937, were actually paid an amount which equals $1.54 per hour of straight time actually worked—a difference of 59 per cent. On the same basis, road passenger enginemen, whose straight-time rate per hour paid for was $1.32 an hour, actually received $1.91 an hour for the straight time actually worked, a difference of 44½ per cent. The 160,000 road-service train and engine employees, with an average rate of 86 cents per hour of time actually paid for, were paid at the rate of $1.16 per hour of time actually worked.

The straight time for which these 160,000 highly privileged employees were paid, but for which they did no work cost the railroads $83,000,000 in 1937. This is 84 per cent as much as the amount required to meet the recent increase of the 800,000 non-operating employees—about 4 cents an hour or better than $100 a year for each of them.

Impressive Advances In the Welding Art

A study of the trends of application of metallic arc welding reveals that the impressive advances made in this art have affected many economies in the maintenance of motive power and rolling stock, as well as in the construction of rolling stock. Welding has ceased to be an incidental tool restricted to a limited field of minor applications, and has acquired the status of an essential fabricating method which is responsible for numerous long-range economies in the railway field.

It required some forty years of intensive study to make this process suitable for assembling structures in which safety and dependability is of vital importance. The great obstacle was that liquid steel, while passing through the arc, picked up harmful elements from the atmosphere so that the weld zone did not equal the full strength of the adjacent parent metal. This obstacle has been overcome by coated electrodes. It has become possible to deposit weld metal which is 100 per cent as sound and strong as the material which it joins. Thanks to this refinement in the process, the designing engineer can figure his weld as being the strongest portion of his structure instead of a zone of reduced strength as in the early days of the art. This development is the real basis of important design trends of recent years. The advantage gained by arc-welded construction with modern welding materials and control methods is that designing engineers are relieved of former restrictions and can make almost any disposition of metal which they desire in their structures.

Within the past few years, the railroads have made significant advances in the welding of rolling stock which, together with the application of high-tensile low-alloy steel and careful distribution of metal in the underframes and superstructures, have permitted considerable reduction in tare weight. Many of the recently built locomotives have been constructed with welding liberally applied to the firebox, combustion chamber and barrel courses. One experimental locomotive boiler, that on the Delaware & Hudson, is completely welded.

The composite result is a new order of achievement in production and maintenance of motive power and rolling stock, a movement which has progressed far enough to establish itself soundly and firmly. Although the coated electrodes cost more per pound than bare wire, their sales have increased in volume approximately 700 per cent since 1933. Engineers in charge of design and maintenance of motive power and rolling stock have been quick to realize the saving effected by the application of welding, and it is only reasonable to expect that this art will find even more extended use in the railway industry.

New Books

Resistance to Heat Checking of Chilled Iron Car Wheels, and Strains Developed Under Long-Continued Applications of Brake Shoes. *A report of an investigation conducted at the Engineering Experiment Station, University of Illinois, in cooperation with the Association of Manufacturers of Chilled Car Wheels, by E. C. Schmidt and H. J. Schrader. Published as Bulletin No. 298 of the Engineering Experiment Station, University of Illinois, Urbana, Ill. 50 pages, 6 in. by 9 in., paper bound.*

The investigation, the results of which are presented in this bulletin, was undertaken primarily to study the effects of long-continued applications of brakes upon the treads of chilled iron car wheels, particularly in regard to the development of heat checks, cracks, and brake burns. The secondary purpose was to determine the strains and the stresses set up in a wheel under such brake applications.

Repeated brake applications were made to six different wheels for a total of 5,400 travel-miles of brake application. These tests equalled the braking effect of a freight-car weighing 68 tons traveling at a speed of 15 to 25 miles per hour down grades as steep as 4 per cent. Each application was continued for a travel distance of 20 miles. It was found that brake pressures exceeding 3,000 lb. caused the wheel treads to show cracks of such size that the wheel would be discarded from service. The repeated tests, including 270 brake applications, showed that lower brake pressures did not damage the tread. Results of these tests throw new light upon wheel damage caused by mountain grades, and also by sticking brakes.

Gleanings *from the* Editor's Mail

The mails bring many interesting and pertinent comments to the Editor's desk during the course of a month. Here are a few that have strayed in during recent weeks.

But *It Is* a Business!

Twelve years' experience as railroad machinist left me with no business sense of profit and loss. Material charges, sources of supply, payrolls, overhead and accounting costs meant nothing to me. A mechanic, or a machine, was just something to get work done with. What little planning I did was for the purpose of making a record, or from just intense interest in the work, and many times just plain showing off.

Don't Antagonize Railroad Fans

The emotion aroused in a great majority of onlookers by the mere passing of engines and trains is clear proof that railroad equipment still has a very strong sentimental attraction for the general public, and it is distinctly up to the railroad managements to capitalize upon that fact to the utmost, even if such action involves a little extra "trouble," or a more courteous attitude toward so-called "nuisances." After all the railroads have been through in the last decade, and in view of the more or less gloomy outlook for the future, it would seem obvious that no possibility of acquiring new friends or of retaining old ones should be neglected. I know very well that those laymen who formerly showed more than ordinary interest in American railroad equipment and operation were too often regarded as inquisitive intruders and sometimes treated with positive rudeness. No valid excuse can be offered for the existence of such an attitude toward potential friends today. While it is true that people without a thorough understanding of the exigencies of railroad work will sometimes make unreasonable requests, such cases must be handled with tact; if ill feeling is to be prevented.

Cultivating the Younger Generation

Your indorsement of plant visitations, etc., by groups of school children should be pondered in some official circles. How many railroad officials grasp the real significance of securing and holding the enthusiastic support of the growing generation? Whenever and wherever the opportunity presents itself, these young people should be imbued with the idea that the railroads are not a decadent institution, in order to counteract the propaganda that flows ceaselessly from competitive sources. This propaganda has, unfortunately, already infected too many present-day grown-ups. If the infection can be spread to a majority of our future citizens, then indeed the cause of the railroads will be irretrievably lost. Some years ago, one of the English main lines began a campaign intended to awaken the interest and enlist the sympathy of "boys of all ages." In addition to running cheap excursions at intervals from various points on the system to the central locomotive workshops, this company has published a unique series of illustrated booklets dealing with its locomotives and various phases of railroad construction and operation. Approximately 200,000 copies of these have been sold at a price of 25 cents each. It is doubtful if any immediate pecuniary profit has been made on the publications, but who can estimate their ultimate value to the company?

Deep in the Rut

Perhaps the various departments have gotten into ruts so deep they can no longer see what the other fellow is doing, as it is readily apparent that acts to effect economy in one department can become the cause of excessive expense elsewhere. Have the specialized habits of years caused a wrong viewpoint?

What Do These Services Cost?

There are two special services railroads are furnishing their patrons for which no extra charge is being made, and I have been wondering what their cost is per year to the railroads. One of them is air conditioning of railroad passenger train equipment. Don't you think it would be interesting if one could know what the total cost to a railroad per annum is for the maintenance per unit of equipment, equipped with air-conditioning apparatus? All the cost should be considered, including the expense of all employes—labor and material, expense accounts, etc., even to that of the special men assigned to engineer and supervise it. Another item I have in mind is furnishing special equipment for special loading, such as cement cars, automobile cars equipped with automobile loading devices, special container cars used for hauling dolomite, lime and other similar materials. What expense are these to individual railroads, including upkeep costs and the cost of cars lying idle waiting, because they cannot be used for other purposes? If the annual cost of these items were known, no doubt it would be helpful and would be useful many times. Shippers are obtaining the use of such equipment without any additional cost, and why should one shipper be furnished with special conveniences for his shipments and another denied, without any additional cost?

Special Attention Should Be Given to Cutting Tools

One very important factor in connection with machine tool operation in railroad shops receives too little attention. I refer to proper equipment and personnel adequately to take care of the heat treatment, repair and resharpening of cutting tools. In my opinion, every railroad shop should have a thoroughly trained heat treater. Many of the steel companies are more than willing to co-operate in training such a workman. Too often a "run of mine" blacksmith poses and is accepted as thoroughly proficient in this line of work. In all fairness to the blacksmith, unless he has made a thorough study of this subject, he is not qualified to harden and temper modern high speed steel tools, which will perform at their maximum efficiency. A capable heat treater is the first essential. His department should have temperature controlled furnaces and proper drawing baths, all equipped with pyrometers. The pyrometers should be checked at least every 60 days to insure their accuracy. After hardening and drawing, all tools should be checked, preferably on the Rockwell hardness tester, before placing in service. A properly hardened and tempered high speed tool should test from C 62 to C 65 Rockwell. The tool room should be equipped with several types of tool and cutter grinders properly to sharpen the various sizes and shapes of cutting tools. The number of workmen in this department should be sufficient to maintain sharp tools at all times, regardless of how large the general force may be. Unfortunately, quite frequently the proper care of tools is given second place to production. This is basically wrong, as good production can only be obtained with properly maintained cutting and machine tools.

THE READER'S PAGE

Failure of Locomotive Parts

To the Editor:

A section of the report by the Committee on Locomotive Construction at the 1937 meeting of the Mechanical Division was concerned with the failures of axles and crank pins. In the Daily Edition of the Railway Age for June 18, 1937, page 1004D96, you showed the results of a questionnaire covering the period January 1, 1931, to December 31, 1936. Twenty-nine representative railroads out of 38 sent in returns. The distribution of failures by location on the axles and crank pins was as follows:

Axles

13.9 per cent occurred in the wheel fit
86.1 per cent occurred outside of the wheel fit

Crank Pins

30.7 per cent occurred in the wheel fit
69.3 per cent occurred outside the wheel fit

From this it is evident that the greater proportion of these fractures should have been detected while they were still in a progressive state.

It also appears that 90.1 per cent of all axle failures were main driving axles and also that main crank pin failures constituted 78.4 per cent of all crank pin failures. If special efforts could therefore be made to locate progressive fractures on main driving axles and main crank pins occurring outside the axle fit and pin fit, a very large percentage of the failures in service could be prevented.

Does this not suggest a device or method perfected to the point that will preclude errors due to visual inspection and the fallibility of the inspector—a device or method so perfected that each and every one of these progressive fractures occurring outside the fit will be detected before a break occurs? Here is a challenge to designing engineers and scientists.

One railroad has practically eliminated service failures by the simple expedient of applying a service age limit to their main pins and axles. Five years, exclusive of storage, condemns all passenger main axles and all main pins. Since this has been in effect the number of failures on this road has been remarkably low.

Anent F. H. Williams in the *Railway Mechanical Engineer,* the following observations from various persons, all practical, have been made to this observer:

"Tool marks are one of the factors in fractures, where the volume of material is low. As the volume of material increases, the same depth of tool marks as a fracture factor decreases in the same ratio as the volume of material increases."

"Mr. Williams is correct. Sloppy work should not be condoned. Refinements in surface finish at known critical points pay dividends in longevity."

"Unless the finish is sloppy, ordinary tool marks are seldom more than .003 in. deep. A deep tool mark is undoubtedly a factor in a fracture, if it should happen to coincide with the axis of fatigue stress."

"Mr. Williams—the answer to metallurgists' prayers."

"Attributing fractures to tool marks—in some cases such are unquestionably the cause, but the inertia effect when shutting off at high speed or drifting to any considerable extent at speed, is a much more serious phase of the problem."

"One must admire the pioneering urge. All pioneers meet resistance, but there is no denying the fact that pioneers take us out of the rut, stir the imagination and procreate new thought, sometimes in fallow fields."

"Mr. Williams is blazing a new trail. One can parallel a blazed trail and arrive at the same destination."

"Laboratory findings do not always work out as expected in the crucible of operating conditions."

"Elimination of tool marks would remove this controversial bone of contention from the picture. To take the position that any one factor should bear the onus of the fracture is untenable."

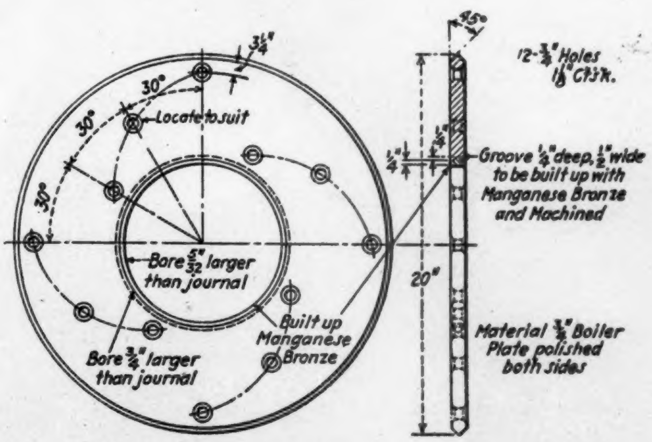
"Constant striving for improvement is often accelerated by pioneers going tangent to accepted practices."

Frank W. Alward.

Floating Liners Eliminate Thermal Checks in Wheel Hubs

To the Editor:

On page 410 of the September, 1937, issue of the *Railway Mechanical Engineer,* General Foreman asks: "What causes thermal checks at the hubs of engine-truck wheels?" Several years ago we had the same trouble with thermal checks resulting from hot engine-



Floating hub liner for engine-truck and trailer wheels

truck wheels caused by excessive hub friction. Such trouble resulted in many engine failures and delays, and the maintenance expense of replacing brasses and lateral rings was high.

To eliminate such failures we cut down the resistance on the rocker rigging on some of our engines, squared up the frames and jaws, and applied floating lateral rings made from ¾-in. boiler plate as shown in the drawing. We also made an oil cup out of 3½-in. pipe to lubricate the floating rings with engine oil. When we applied a set of floaters we gave the wheels ¼-in. lateral.

We now have all of our passenger and freight locomotives equipped with such floating liners. This has practically eliminated hot boxes on engine-truck and trailer boxes, but when hot boxes are reported, it is the packing that is the source of the trouble.

Claude J. McCready

Box car underframe in the welding jig which provides for down hand welding exclusively

With the Car Foremen and Inspectors

One of the new Union Pacific 50-ton box cars equipped with a welded alloy-steel underframe

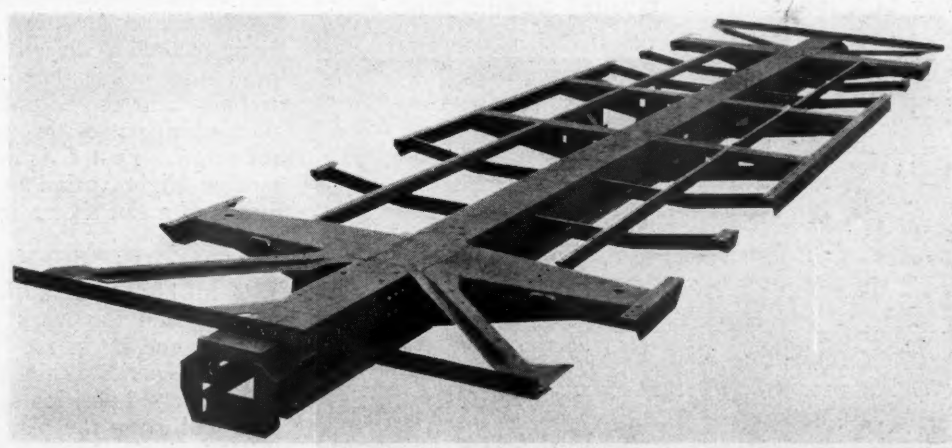
New U. P. Cars Have All-Welded Underframes

The Union Pacific is building 1,900 50-ton, lightweight, steel-sheathed box cars, of a modified A. A. R. design with all-welded underframes, in the Omaha, Neb. and Portland, Ore. shops of this road.

The cars are of moderate lightweight construction, weighing 39,300 lb. The car bodies are of alloy steel with the exception of the center sill, safety appliances, and a few heavy-section brake forgings. The trucks are the double-truss spring-plankless type with one-wear wrought-steel wheels and high-tensile cast-steel side frames and bolsters. The bottom connection does not pass through the truck bolster. These trucks weigh approximately 13,400 lb. per car set.

The underframes are welded throughout, and are being furnished by The Ryan Car Company, Chicago. They are of Cor-Ten steel with the exception of the center sills, which are open-hearth steel, A. A. R. Z-26 section. The strikers are fabricated and welded to the center sill. They are designed to accommodate the Union Metal Products Company's lightweight centering device. The front draft lugs are drop forgings with the key slot reinforcement projecting through the sill and welded to the center sills. The body-bolster center fillers are high-tensile steel castings, heat-treated and riveted to the center sills and body center plates. The body center plates are drop forgings, welded to the center-sill lower flanges.

The body bolsters are pressed pans, welded together to form a box section and welded to the sills. They have a reinforcing splice plate welded across the joint on top. The crossbearers are a box section built up of angles and plates and are welded to the center sill. They have a splice plate on the bottom with center-sill spreader angles attached. The crossties are 4-in. rolled channels with square ends welded to the center sills and side-sill reinforcements. The floor stringers are channel pressings with the bolster and crossbearer attachments pressed on the ends. The brake system brackets are all welded to the underframe.



The welded underframe made of high-tensile alloy steel

The underframes are being built, at the Ryan plant, where all welding is done in a down-hand position. This involes the use of revolving jigs on both sub-assemblies and the complete underframe.

The car sides, made of Yoloy and Cor-Ten steel, are furnished by the Youngstown Steel Door Company. The sheets are .067-in. thick. Five hundred car sets have,

16 per car, 3-in. 5.1-lb. open-hearth steel Z-posts and 1,400 cars have 3-in. 4.3-lb. high-tensile Z-posts. The corner posts are $\frac{5}{32}$-in. pressed W-sections of high-tensile steel. The side plates are $\frac{3}{16}$-in. W-section, 7.8-lb. per foot, copper-bearing open-hearth steel rolled in a Yoder mill. The side-sill angles are 6-in. by 3½-in. by ¼-in. Yoloy steel.

The doors, furnished by the Youngstown Steel Door Company, are equipped with bottom lift fixtures. The door sheets are made of 14-gage (.077 in.) high-tensile steel. The roof is the Murphy solid-steel type, made of 16-gage Cor-Ten (.06-in.) sheets with ⅛-in. low seam caps.

The car body is lined throughout with a ½-in. plywood ceiling, 25/32-in. side and end lining, and 1¾-in. decking. The floor at the door opening on 1,800 cars is bagac and 100 cars are equipped with Chicago Hutchins steel plate. The ends are the Union Metal Products Company's Dread-naught with $\frac{5}{32}$-in. top sheets and $\frac{3}{16}$-in. bottom sheets, of Man-Ten steel.

These cars, assembled in the railroad's shops at Omaha and Portland, are painted with chromate primer and finished with iron-oxide synthetic freight car paint. Load deflection and impact tests, conducted by the railroad, are said to have proved the satisfactory character of this car design and the construction methods incorporated.

Testing the D-Bodies Of Metallic Joints

By A. Skinner*

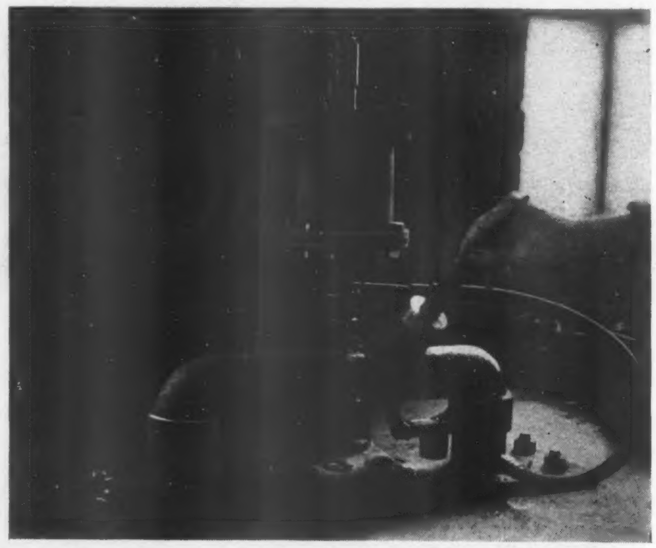
Metallic joints used in steam heat connections between passenger cars are subjected to alternate high steam pressures and condensation which sometimes cause the main D-body sections to rust through or crack, with resultant failures in service. Even when failures do not result, these weakened and defective D-bodies often find their way back into service in repaired metallic joints where

Device used in testing the D-bodies of metallic steam-heat connectors

they again present the hazard of interruptions in steam heat service. To avoid this possibility, the device illustrated provides an effective means of testing all D-bodies before being assembled in overhauled metallic joints and thus assuring that they are in good condition for an extended period of further service. The device is primarily a car department tool used by steam fitters and should be located at or adjacent to the coach yard tracks.

* General foreman, A. T. & S. F., Corwith, Ill.

The appearance of the testing device before application of a D-body is shown in Fig. 1. The device consists essentially of two steel D-body supporting posts *R* and *L* mounted on base plate *B*, and bracket F which carries a small air-cylinder *C* designed to hold the D-body against suitable gaskets in the supporting posts while air pressure for testing purposes is applied through a flexible rubber hose connection to one of the posts. The base plate *B* is ⅝ in. by 6 in. by 25 in., being bolted at a convenient place on the work bench adjacent to an



View showing how a soap-suds test is made on this device

air supply line. Each of the steel supporting posts is 2⅝ in. in diameter by 3 in. high, being equipped with ⅜-in. rubber gaskets secured to the upper surfaces by set screws which pass through the rubber and are threaded into the posts. Post *R* is fixed in position, being secured to the bottom plate *B* by ⅜-in. countersunk head stove bolts. This post has an air port drilled horizontally near the bottom and connecting with a vertical port which passes through the center of the gasket and set screw. Post *L* is adjustable horizontally to accommodate slight variations in the length of D-bodies by means of a slot shown in the illustration and a ½-in. T-head bolt.

Bracket *U* is also made of ⅝-in. steel, 6 in. wide by 17¼ in. high, over all, and is fastened securely to base plate *B* and the work bench by means of four bolts through one leg of the *U* as illustrated. The upper leg of the *U* carries a 6-in. by 6-in. cylinder *C* rigidly bolted in an inverted position so that the application of air pressure will cause the piston to move downward and hold the D-body firmly against the rubber gaskets on the supporting posts. While the piston is in this position, air at the same time passes down through a port in the piston rod into the ⅛-in. horizontal nipple and ⅜-in. rubber hose connection to the bottom of supporting post *R*.

Air is supplied to or exhausted from cylinder *C* and supporting block *R* by means of a three-way valve, the handle of which is shown at *V*. The amount of air pressure admitted to the cylinder is controlled by the operator using this 3-way valve and ordinarily does not exceed 45-lb., which is more than enough to indicate any leak when the D-body is given a soap suds test. The

actual operation of making a soap suds test of a D-body using this device is shown in Fig. 2.

Improved Coffing Hoist Reduces Lifting Hazards

The Coffing Hoist Company, Danville, Ill., is now offering to the railroads, and general industry, an improved design of Safety-Pull hoist which is said to reduce or, in fact, practically eliminate hazards in lifting and pulling operations. It is designed on the ratchet-and-pawl principle, which permits using the hoist in a variety of positions, including those with limited head room.

Among the safety features incorporated in this hoist, as now designed, is the push-button control. When the load has been elevated and it is desired to lower the hoist, the operator simply pushes in the button and the hoist's action is reversed. This control also acts as a safety stop; if the worker's hand should slip off the handle while operating, this device automatically and positively locks the handle before it can revolve or cause any damage.

Two other separate safety stops prevent the handle from whirling around and causing injuries to workmen. An intermediate locking pawl works alternately and intermediately with the main locking pawl and enables the

Applying a generator belt with a Coffing Safety-Pull hoist

load to be stopped in locking position at half the length of the regular stroke. This added pawl also serves as an extra safety. In the case of excessive overloads, the handle bends before any other part of the hoist will give. This serves as a warning to prevent the chain from breaking or hooks from straightening out and dropping the loads. The hoists weigh from 14 to 150 lb. and are made for loads from ¾ to 15 tons. Each hoist is factory tested to lift 100 per cent overload.

The uses to which this hoist may be put in railway service are numerous, including all sorts of lifting and pulling jobs in both locomotive and car repair work. It is perhaps most widely used by car men in connection with lightweight steel frames set up over trucks to assist in truck dismantling and assembling operations, as described in the March *Railway Mechanical Engineer,* page 110.

The versatility of this hoist in pulling operations is nowhere better indicated than by its use in applying generator belts, as shown in the illustration. However, where a large amount of this work of applying or adjusting either flat or V-belts has to be done, a somewhat lighter and simpler adaptation of this hoist has been developed. This ratchet-lever puller, with a capacity of two tons and weighing only 12 lb., has a free-chain feature for quick hook adjustment and two feet of Diamond chain of ⅝ in. pitch. A C-clamp hook is used for attaching the hoist to the truck sill on the end of Pullman-type trucks. For other types of drives, special adapters may be furnished and in some cases an ordinary grab-hook chain is used. If two feet of chain is not ample, more chain can be added to suit conditions. Like other Coffing hoists, this one requires little head room; therefore, it is also well adapted for installing and repairing air-conditioning equipment.

How to Stop Sweating of Steel Box Cars—A Suggestion

By R. H. Salter

Steel box cars have a tendency to sweat on the inside when loaded with warm lading during the cold weather, causing considerable annoyance to shippers as well as expense to the carriers. It is the purpose of this article to define the cause of sweating of steel box cars, to point out a few of the results of the condition, to discuss briefly what has been learned by experience with a similar situation and what correctional methods were applied in that situation, and finally to suggest a remedy for sweating of steel box cars.

At the outset we must bear in mind that the sweating of the interior of steel box cars is purely an atmospheric condition, or put in other words, the moisture which is precipitated comes from a certain and given amount of air which is locked inside of a very tight car. In the northern sections of the country, winter weather conditions with temperature at zero degrees or even lower and humidity at close to 100 per cent are common.

Shippers often find it convenient to load their product promptly and even before it has had time to cool. This may be due to brisk sales and limited warehouse facilities. Consequently, manufactured commodities are sometimes loaded at temperatures of 100 deg. F. or even higher. Loading operations require periods of time of varied duration, and during these periods the car doors are open. The presence of the hot lading causes the temperature of the air in the car above the lading to rise to a temperature very close to that of the lading. Naturally, the humidity would fall were it not for the high state of the outside humidity and the open car doors. The humidity inside the car promptly finds its equilibrium with that on the outside.

By the time loading is completed, the air within the car has attained a high temperature as well as a high humidity. The air becomes locked in the car and, as the car walls are made of thin steel plate, they offer little, if any, resistance to heat transfer. A rapid cooling of the lading and the air above the lading takes place. A drop of 10 deg. in temperature causes a rise of 30 per cent in humidity. The only possible result is condensation or sweating on the interior of the steel box cars. As the cooling of the lading continues, the humidity of the air in the car will remain at 100 per cent. This is the dew point, the point of complete saturation, and condensation will continue until the vapor content of the air has been precipitated in the form of water. In very cold weather, the interior of the car becomes coated with frost and even icicles form along the ceiling of the car. In cars moving to warmer regions, the frost and icicles

melt and water damage to the merchandise results.

It is well to bear in mind that the actual dripping of water from the car ceiling is not the only cause of damage to merchandise in sweating cars. Condensation in a given quantity of air sets in when the relative humidity of the air reaches 100 per cent. A humidity of 100 per cent in a car or warehouse is decidedly harmful to many classes of manufactured products stored therein.

The foregoing briefly defines the cause of sweating of the interior of steel box cars and also points out some of the harmful results. The remainder of this article will explain what has been learned by experience in a situation which, in many respects, was parallel to the sweating in steel box cars. About 20 years ago there was developed in Minnesota what is known as the full-view railroad-track scale pit. These pits are 50 ft. long, 10 ft. wide and 8 ft. deep, which dimensions approximate those of the largest box car. The walls and bottom of these pits are constructed of solid concrete 2 ft. thick, while the top of the pit is covered by a platform or deck made of 2-in. planks well matched, tarred and painted. This construction made them very nearly air and water tight.

These pits, containing the iron structural and operating parts of the scales, were believed to be the acme of perfection in track-scale construction. This, however, was soon found not to be so. The very first difficulty encountered was a pronounced condensation and sweating condition. The pits were always wet and clammy, due to the high state of humidity therein, and this caused very rapid deterioration of the iron scale parts. It became so alarming that something had to be done about it.

The subject was brought up at a scale-experts' convention for consideration. In a discussion of less than an hour's duration, a plan was adopted and the following described installations recommended: One hole 10-in. square was cut through the scale platform at each end. From this opening a sheet steel spout, open at the lower end and covered at the top by a floor register, was extended downward to within 5 in. of the floor of the pit. On the scale house was erected an 18-in. sheet-steel vent pipe 12 ft. high which tapped the scale pit at the top directly under the platform. This arrangement established a system of gravity ventilation which set up a very gentle current of air through the pit. The system functions satisfactorily at all times regardless of weather conditions, without cost or attention. All scale pits in which this system has been installed are dry.

On the basis of the foregoing experience, would one not think that the only practical way to overcome sweating in steel box cars would be the installation of a properly designed system of gravity ventilation? The installation of such system in a scale pit was comparatively easy. The arrangement of air conductors and vent pipes is not in the way nor is its free action ever obstructed.

The designing of a system for ventilating a box car is more difficult for a number of reasons. The car is a moving object with 100 per cent exposure to the weather. At times it may encounter a wind velocity in excess of 100 m. p. h. While the train is traveling at high speed, a rush of air is set in motion down and around the end of the car. The air may be filled with flying cinders, dust, rain or snow. All this must be kept out of the car. The ventilation system must be so constructed that it will not be in the way of the lading or be obstructed by the lading, it must not add to the cost of the car, and above all things it must work. This is a large assignment, but it can be done. The wonder is that it was not done long ago. For all these years the carriers have been patiently paying out a part of their hard-earned revenues on damage claims caused by the sweating of their own equipment. Damage of this nature to goods while in transit must be paid for by the carriers; it is a cash outlay and an absolute loss. Could this not be saved by proper ventilation of steel box cars?

Malleable-Iron Collapsible Side-Stake Pockets

The accompanying illustration shows a typical installation of a collapsible malleable-iron side-stake pocket used on a gondola freight car. The pocket consists of a main link malleable-iron casting, two malleable-iron brackets or bearings, and one forged-steel knee brace. The main link in this case has an inside dimension of $4\frac{1}{16}$ in., making it suitable for 4-in. by 4-in. posts. It may be made, however, for different sizes of stakes. The side brackets have bearing pockets for the anchor legs of the main link and resting flanges for the knee-brace terminals. Strength and toughness, facility of operation,

Collapsible side-stake pockets applied to P. & W. Va. gondolas

and lightness of section are provided by the design and composition of the pocket, and the side arms of the link frame are ribbed to give the best combination of strength and lightweight section.

The design shown is of the kind installed on 100 Pittsburgh & West Virginia cars during the past year. A variation of this design was employed on another railroad. A double main link was constructed to provide post clearance past the top side plate on the freight cars in question. The weight of the double-link casting is 8.4 lb. as against 3.7 lb. for the single-link type; in each case, the brackets weigh 3.5 lb. per pair and the knee brace forging weighs 2.3 lb.

The view in the gondola shows some of the pockets in active position and some in collapsed state. The assembled pocket opens and closes easily. The knee-brace feature permits easy placing of stakes without resistance or clamping on the part of the pockets. Similar advantages are obtained when removing posts, as the main link is prevented from raising much above the horizontal by the design of the link surface resting against the car side. When posts are moved, the pockets automatically drop into collapsed position.

This side-stake pocket is manufactured by the Fort Pitt Malleable Iron Company, Pittsburgh, Pa., a member of the Malleable Founders' Society.

Decisions of Arbitration Cases

(The Arbitration Committee of the A.A.R. Mechanical Division is called upon to render decisions on a large number of questions and controversies which are submitted from time to time. As these matters are of interest not only to railroad officers but also to car inspectors and others, the Railway Mechanical Engineer will print abstracts of decisions as rendered.)

Axle Dimensions—Original Record Altered After Rendition of Bill

On November 9, 1935, the Chicago, Burlington & Quincy applied new wheels to a Seaboard Air Line 80,000 lb. capacity box car, in place of wheels removed because of owner's defects; the axle removed was secondhand. In the original record of repairs, the C. B. & Q. showed that new wheels were mounted on an axle with a center diameter of 5 3/16 in., 1/16 in. below the condemning limit.

The Seaboard Air Line took exception to the application of the scrap axle, after which the C. B. & Q. changed the diameter to read 5 13/16 in., quoting Rule 7, section 4, paragraph 3 as authorization for the change. The S. A. L. declined to accept the correction, contending that the decision of Arbitration Case 1722 prohibits any correction on the repair card after the bill has been rendered; the owner also declined to submit joint evidence to support the claim that a scrap axle was applied with this car. The C. B. & Q. contended that Case 1722 is not parallel, and that the claim for wrong repairs must be supported by joint evident in accordance with requirements of A. A. R. Rule 12. In rendering a decision on Nov. 8, 1937, the Arbitration Committee stated: "According to the agreed statement of facts, the original record of repairs as written at the car shows center diameter of axle applied as 5 3/16 in. There is no authority under the rules to alter this record without actual re-inspection of the axle. Therefore, the contention of the Chicago, Burlington & Quincy is not sustained."—*Case No. 1756, Seaboard Air Line versus Chicago, Burlington & Quincy.*

Questions and Answers On the AB Brake

Brake Cylinders (Continued)

278—*Q.—What must be done before the packing cup is applied?* A.—The felt swab on the piston must be carefully cleaned, relubricated and adjusted to make contact all around the cylinder wall.

279—*Q.—What attention should be given the brake cylinder walls?* A.—They should be thoroughly cleaned, rust spots removed and lubricated with a good grade of graphite air-brake-cylinder grease.

280—*Q.—What attention should be given the release spring?* A.—It must be inspected and cleaned, and any rust or dirt removed.

281—*Q.—What other features in the non-pressure head should be given attention?* A.—The hair strainer and piston-rod seal must be removed and cleaned.

282—*Q.—How can the hair strainer be removed?* A.—It can be removed from the inside of the non-pressure head, being held in place by a wire spring; the strainer parts are released for removal by closing the spring ends.

283—*Q.—What should be done with the piston sleeve?* A.—It should be cleaned and inspected, all rust spots removed, and an examination made of the piston-sleeve seal rings for wear. The piston-sleeve swab should be examined and renewed if necessary.

284—*Q.—Before replacing the swab, what should be done?* A.—The swab should be soaked in a good grade of light oil.

285—*Q.—Why is this precaution necessary?* A.—If the swab is not thoroughly soaked, the piston sleeve eventually becomes dry, due to the fact that a dry swab would absorb the lubricant from the piston sleeve.

286—*Q.—When assembling the swab and seal rings in the non-pressure head what precaution must be taken?* A.—After the sleeve is well covered with graphite grease, apply the swab over the piston and into the stuffing box, being sure to ascertain that the contracting spring ring, which holds the swab in contact with the rod, is around the outer diameter of the rod. The swab container is placed over these, and followed by the three brass rings. Additional graphite grease is then applied to the top ring, after which the follower plate is bolted in place.

Right-Angle Drill For Close-Quarter Work

The illustrated Thor right-angle drill with a possible working clearance of only 2 3/8 in. and built in 3/16 in. and 1/4 in. capacities is now being marketed by the Independent Pneumatic Tool Company, Chicago, as the U14R drill. The drill head on this unit measures only 2 1/8 in. overall and the angle attachment can be turned and clamped in any position, making it possible to drill in places formerly inaccessible.

Thor 3/16-in. portable right-angle drill

This addition to the Thor line weighs 3 lb. and has an overall length of 9 1/4 in. Equipped with 1/16-in., 3/32-in., 1/8-in., 5/32-in. and 3/16-in. collets for twist drills, it offers a wide drilling range. It can also be supplied with a spindle to take a 3/16-in. chuck. The spindle offset is 13/32 in. This drill operates at a speed of 2,700 r.p.m., but it can also be furnished with speeds of 3,750 r.p.m. (U14R) and 5,100 r.p.m. (U15R). Construction features include a triple-insulated hand-wound armature, a commutator built on a brass sleeve to eliminate high bars and floating segments, alloy-steel spiral helical gears and a radial-vent cooling system.

IN THE BACK SHOP AND ENGINEHOUSE

Tools Tipped with Non-Ferrous Alloy and High-Speed Steel

At the West Albany shops of the New York Central, turning tools are being fitted with non-ferrous alloy tips and high-speed tool-steel tips by methods, developed at the shops, which have practically eliminated tool replacements due to broken or loose tips. The tool shanks are

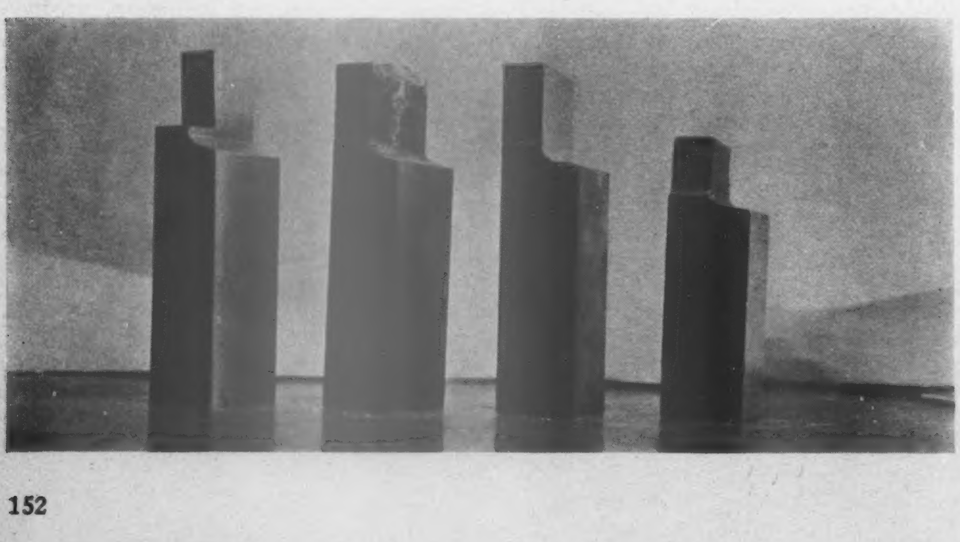
Tools tipped with non-ferrous alloy are heated by an oxyacetylene flame

made of scrap tire metal machined to the desired shape for the various turning operations for which the tools are intended. For example, one of the tools, which is used for machining cylinder packing rings and is shown in the illustrations, is about 6 in. long and machined to take a ½-in. by ¾-in. by 1⅛-in. non-ferrous alloy tip; it is used until but $\frac{1}{16}$ in. of the tip remains, during which 3,000 rings are machined. One of the illustrations shows the tool ready to receive the tip, the tool with the tip applied but not ground, the tool ground ready for use, and the tool after turning 3,000 rings; the latter shows the $\frac{1}{16}$ in. non-ferrous alloy remaining on the tool. The production cost per packing ring per tool is but 0.066 cents, since 3,000 rings are machined per tool which costs $2.00, including labor and material charges.

The fact that the tool can be used until but such a small piece of non-ferrous alloy tip remains is attributed to the method used in applying it. The method of applying the tip is as follows: First, the tip of the shank is dipped in tetrachloride to remove grease spots, after which it is clamped in a vice. The tip is then applied to the shank with a pair of tongs to avoid handling with the fingers which might put an oil spot on the tip. With the tip in place, the shank and sides of the tool are heated with an oxyacetylene torch to a cherry red color, using a non-oxidizing flame; during this heating a good borax is used to clean the seat of the shank and the tip, the borax being applied only to the top of the tip. The welding rod is then touched to the tip after warming the rod so as to prevent cracking the tip which might occur if a cold rod were placed against the tip. The heating is continued until the bronze runs freely on top of the tip, after which it flows beneath the tip by capillary action. When sufficient bronze has flowed under the tip, the tip is pressed into place with the welding rod and immediately placed in lime or some other medium to prevent too rapid cooling which would cause a check or crack in the tip.

The shanks of the tools tipped with high-speed tool steel are also made of scrap tire metal, and the tips are hammered out of scrap butt ends of high-speed tools. The portion of the shank machined to receive the tip is coated with a $\frac{1}{32}$-in. layer of steel-cement flux found especially adapted for the purpose and the tip is set in place, after which the assembly is placed in a pyrometer-controlled furnace and heated to 2,350 deg. F. As soon as this temperature is reached, the assembly is removed from the furnace, the tip is pressed solidly in place, and then cooled to room temperature under an air blast. The tool is reheated to 950 deg. F., after which it is removed from the furnace and allowed to cool naturally to room temperature.

One application of the tools thus tipped with high-speed steel is the turning of engine-truck and car wheels. Normal production with each tip is 25 wheels per grind; with five grindings per tip, the production per tip is 125 wheels. One tool shank can be re-tipped four times, thus making a total production of 500 wheels per tool. Application of the first tip costs 40 cents while the re-

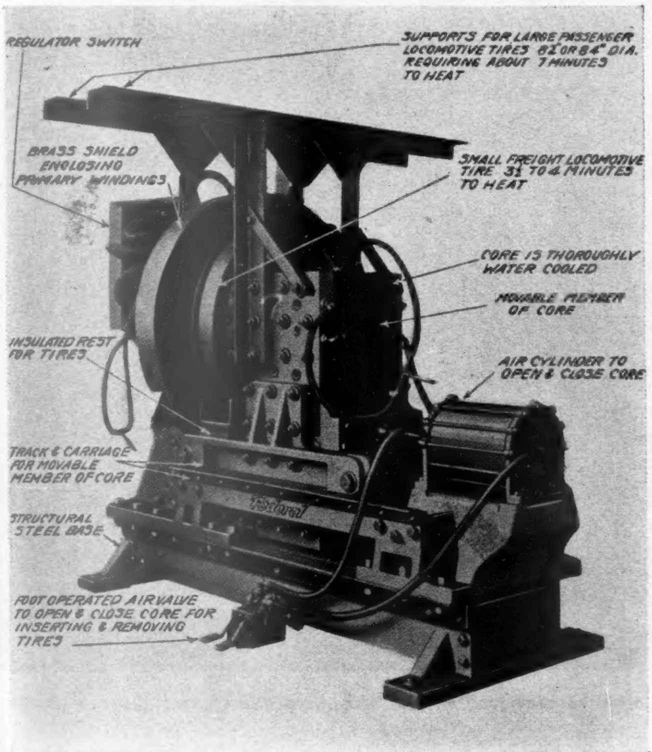


Cylinder-packing parting tool, showing the tool-shank, two views of the tool after the tip has been applied, and the tool after parting 3,000 rings

tipping costs 20 cents each, including labor and material, or a tool cost per tool of $1.00; thus, the tool cost per wheel is but two cents.

Electric Heater for Locomotive Tires

In the accompanying illustration is shown a sliding-core electric tire heater which utilizes the tire itself as a short-circuit single-turn secondary that heats quickly and uniformly when the primary circuit is closed. All sizes of tires can be expanded preparatory to shrinking onto wheel centers. By using a flexible secondary lead, with



Electric tire heater in which the tire acts as a secondary circuit

contact shoes to clamp onto the tires at diametrically opposite points, the tires may be expanded for removal from the driving wheels when they become worn.

The sliding core of this heater is built with a movable end which travels on rollers and track by means of a double-acting air cylinder actuated by a foot valve. This allows the work to be inserted and removed by a crane. The core is water-cooled by means of bronze plates on sides and in the center, with cooling pipes and ducts cast into them. The pressure device is for opening the core and for holding it firmly together when closed.

If the machine is to heat both freight- and passenger-locomotive tires, it should develop 750 kva. If it is to heat freight tires, only 550 kva. is required. The primary coils should be wound for 440 or 550 volts, preferably the latter, and 60-cycle current. It is equipped with air-cooled and tapped primary windings with five steps for varying the current and voltage through a regulator switch, to suit the work. A double-pole, open-type contactor panel of 1,500-amp. capacity for a 550-kva. heater, or a panel of 2,000 amp. capacity for a 750-kva. heater may be used and operated by an auxiliary contactor of 75 amp. and an operating button, or by a double-pole single-throw hand-operated switch.

Freight tires, 36 in. diameter by 3½ in. thick by 9 in. wide are heated to 450 deg. F. in about 4 min. Passenger tires, 82 in. diameter by 3½ in. thick by 9 in. wide are heated in about 7 min. Due to the absorption of heat by the driving wheels, 60 per cent more time is required to heat tires for their removal than to expand them for shrinking on the heater, built by The Federal Machine & Welder Co., Warren, Ohio.

Wide-Flanged Thermic Syphons

The Lehigh & New England recently equipped a locomotive with five wide-flange Thermic syphons, three in the firebox and two in the combustion chamber. The wide flanges of these syphons are butted together, thus forming the entire crown sheet and eliminating two strips of the old crown sheet in the firebox and one strip in the combustion chamber which would be required if narrow-flange syphons were used; their application eliminates two longitudinal welds in the firebox and one in the combustion chamber when compared with the application of narrow-flange syphons.

The combustion chamber of the locomotive being new, the combustion chamber syphons were laid out on the floor, together with the combustion chamber. The combustion chamber was then applied to the locomotive and welded in place.

In the application of the wide-flanged syphons to the firebox, the entire crown sheet was cut out and ¾ in. excess material was left on the side sheets. The center syphon was then set and bolted in position. Marks were made on the door sheet indicating this position, and the center syphon was unbolted and moved to one side. The two outside syphons were then butted to the marks on the inside door sheet which located the center syphon and the side sheets were marked for the butting edges of the outside syphons. The outside syphons were then removed and the side sheets were trimmed.

With the combustion chamber in the locomotive and the side sheets trimmed, the five syphons were bolted in

The wide-flange Thermic syphons trimmed and ready for application

position. The four longitudinal seams in the firebox and the three longitudinal seams in the combustion chamber were tack welded first with the combustion chamber syphons abutting the back flue sheet. All longitudinal welds were then completed, thus permitting the syphons to expand without any danger of buckling. The circumferential welds at the flue sheet, at the juncture of the firebox and combustion chamber, and at the inside door sheet were then completed in turn.

Two weeks after he came on the job, odds were offered that the new master

STRAW-BOSS

by
Walt Wyre

H. H. Carter, master mechanic of the Plains Division, is rated as one of the best on the S. P. & W. Two weeks after he came on the job, odds were offered that the new master mechanic wouldn't last ninety days. The trouble was Carter couldn't remember he was no longer a foreman. He put in so much time supervising individuals that he had no time left for the job as a whole.

Jim Evans, the roundhouse foreman at Plainville, remembers well when Carter landed there. The new master mechanic paused at the office only long enough to introduce himself to his clerk and look over messages received that day. He spent the rest of the day in the roundhouse.

Evans was, as usual, short of power the day the new official arrived. The 5088 came in with a bursted siphon that would take a couple of days to repair with all of the other work boilermakers had to do. That wouldn't have been so bad if the 5079 hadn't picked that time to break a main pin.

Evans took a fresh chew of "horseshoe," looked the situation over, and decided he'd better rush the work on the 5082 that was on the drop-pit. One more unserviceable locomotive and the local and limited would have to be run as a mixed train with the switch engine pulling it.

mechanic wouldn't last ninety days

"Wish you fellows would kinda throw your feet out," Evans told the machinists working on the 5082. "Looks like I'm going to need her before you can get her finished."

The nut-splitters agreed and went to work with a will. Machinist Cox was laying out the shoes and wedges when the new master mechanic came through the roundhouse.

Carter watched the machinist a few moments without saying anything. The machinist, naturally nervous under the official's staring gaze, forgot measurements and had to remeasure.

"How do you go about laying out shoes and wedges?" Carter asked.

The machinist hadn't gone far with the explanation when the master mechanic interrupted. "I can show you a much better method."

Carter rapidly and sketchily outlined the method he used. It was probably as good or maybe better if the machinist had understood it thoroughly, but he didn't. Besides, he had to start all over from the beginning.

The master mechanic left the machinist struggling with the unfamiliar method of laying out shoes and wedges and went to the machine shop.

Carter stopped at the shaper where Johnson, one of the machine men, was planing a cross-head gib.

As before, the official watched awhile before saying anything, then he asked, "Is that the fastest speed on that shaper?"

"No," Johnson replied, "but it's as fast as the tool will stand."

"Speed it up," Carter replied. "If you'll grind the tool right, it'll stand more speed."

Johnson is an old head and nobody's fool. He knew the shaper tool wouldn't stand cutting the cast iron any faster, but he also knows better than to argue with a newly promoted official. After they have been on the job long enough to learn that a title doesn't necessarily carry with it a monopoly of knowledge, they are less likely to resent a difference of opinion.

"Would you mind showing me how to grind the tool?" Johnson said very courteously.

"Sure I'll show you," the master mechanic agreed.

The tool was ground with a sharper point and more clearances and put back in the shaper. Johnson shifted the gear lever to the next higher speed and started the machine.

"It'll stand running faster than that," Carter said.

The machinist, without replying, stopped the machine and shifted the lever to the next notch. In less than thirty seconds after the tool bit into metal the point burned off.

"Let's try grinding it again," Carter suggested. "Maybe you gave it a little too much clearance."

When the tool burned up again, the master mechanic admitted that maybe it wouldn't stand the speed. "We'll have to see if we can't get a better grade of tool steel," Carter said as he left.

NEXT day Carter started to leave the machine shop when he noticed a nut-splitter grooving some driving-box brasses. He stopped long enough to offer a little criticism and very emphatically suggest changes in the method of grooving the brass.

In the meantime Evans was having troubles of his own. The inspector found a break in the frame of the 5090. She was otherwise a good engine and the foreman, not knowing of the broken frame, had planned to work her and run her east on first 82 about six o'clock that evening.

Evans went in search of Henry Barton. Barton is the best welder in Plainville and a lot of other places, too. He is the only one there that can put a patch on a siphon in a reasonable length of time.

The foreman went to the 5088 and climbed up in the cab. He looked into the fire-box where he expected to find Barton working on the bursted siphon. Barton wasn't there. Instead, a helper was gathering up the tools.

"Where's Barton?" Evans asked.

"Went to look for you," the helper replied. "He's sick and wants to go home."

"I'm sick too," Evans said, "but I can't go home. Was he very sick?"

"Feeling pretty bad, at least, he looked like he did."

Evans swore mildly and climbed down from the cab. He had been figuring on having Barton work overtime welding the broken frame. Jenkins, the machinist welder, is just fair, and Evans didn't much like the idea of putting him on the frame. Besides he would take at least half again as long to get the job done as Barton would.

The foreman walked through the house figuring as he went on how to make eight trains go into seven locomotives without any trains left over. It was a problem that would have puzzled Einstein.

At stall number twelve Evans saw Carter. The master mechanic was instructing a machinist on how to pull a piston when Evans came up. The foreman and master mechanic were not strangers to each other. They had

worked together at another enginehouse several years before.

They exchanged greetings and shook hands. "How's everything going?" Carter asked.

"Oh, about right, I guess," Evans replied. "I've got eight engines to run, only seven in sight, and none O.K. Guess I'd better go to the office and check up on what's coming in."

Much to the relief of the machinist who was pulling the piston, the master mechanic went too.

"Dispatcher wants to know what's lined up for 82," the roundhouse clerk asked when Evans entered the office.

"Wish I knew," Evans replied dryly.

"Say, Jim, that 2735 I just came in on—the bell ringer don't work," an engineer stuck his head in the office and announced.

"Is the east local in already?" Evans asked.

"Yeah," the engineer replied, "I just came in on her."

"How is the 2735?"

"Good engine," the hoghead replied, "except the bell ringer don't work."

"Booster in good shape?" the foreman asked.

"Yeah, working good."

"Tell the dispatcher we'll use the 2735 on 82," Evans said to the clerk.

"But he wants a 5000," the clerk reminded.

"A 2700 with a booster will get the job done," Evans said. "Besides, it's all I've got."

NEXT morning the new master mechanic was on the job bright and early. He was in the roundhouse before eight o'clock and except for brief periods at the office and a short thirty minutes for lunch spent the day in the roundhouse. He managed in the course of the day to ask every man on the job what he was doing and why. Some he asked two and three times and in most cases found fault with what they were doing or the manner in which it was being done. Carter spent nearly thirty minutes with the tank washer showing him how to do a better job washing engine tanks.

About ten-thirty machinist Horton was getting ready to put in a new main pin to replace the one that broke on the 5079. The engine had come in the night before and Evans was in a rush to get it ready to run. The old pin had been burned out. The machinist with his helper had the wheel jacked up and was getting ready to heat the tire to take it off when the master mechanic came up.

"What you going to do?" Carter inquired.

"Take off the tire," the nut-splitter explained. "We're going to put in a new main pin."

"You're wasting time taking off the tire," the master mechanic said.

"We've always took the tire off when we put in a main pin," Horton replied.

"Yeah, there's been a lot of things done around here that's going to be changed," Carter said. "Go ahead and put your pin in."

The machinist and his helper hung a heavy ram to drive the pin. A machine hand had already calipered the hole and was turning the pin.

Horton's helper rigged up a big kerosene torch to heat the wheel. The machine hand had the pin finished before the wheel was hot. He brought the pin in and laid it down on a nearby tool box.

"It ought to be hot enough by now," the master mechanic said a few minutes later.

"Get a couple of men to help handle the ram," the machinist told his helper.

Horton and his helper shoved the pin in the hole. It went about one-fourth of the way and was too tight to go by hand.

"Ram it," the machinist said, with added superlatives.

"You can drive it with a sledge," the master mechanic suggested.

The helper let go of the ram and went to the tool box for a heavy sledge. The helper started to hit. The ram was in the way. He waited until it was swung around parallel with the engine.

The pin moved about one inch and stuck. The few seconds lost getting the ram going allowed the pin to get warmer and stick more solidly. And stuck solidly it was. Even the heavy ram wouldn't move it.

Carter exploded like a bunch of torpedoes thrown in a fire-box. "The master mechanic pitched a hissy," was the way Horton expressed it later when telling about it in the washroom.

Evans came up about the time the master mechanic was having the brain storm. One glance was enough to let the foreman know what had happened. Evans turned on his heel and headed back in the direction from which he had come. His nickel's worth wasn't needed there.

Evans went to the drop-pit to see how things were going on the 5082. He found that the wheels were up but it seemed that something had gone amiss. Cox was standing beside the locomotive looking at it, a puzzled expression on his face. The machinist helper was helping to look, but was letting the machinist do the puzzling unassisted.

"What's the trouble?" Evans asked.

"She's away off," the nut-splitter replied. "I slipped somewhere laying out the shoes and wedges, but blamed if I know where!"

"You've laid out enough shoes and wedges to get them right," Evans said with some irritation in his voice.

"Yes, but I was using a new method, one the master mechanic showed me," Cox said. "Guess I didn't get it exactly."

Evans opened his mouth to say something, but took a chew of "horseshoe" instead and turned and walked off.

Barton was still off sick. Evans had hoped the welder would be back to finish the siphon patch and weld the broken frame. He could wait no longer, though. Four locomotives out of service was at least two too many. The foreman found the machinist welder and told him to weld the broken frame. "Stay with it until you get it finished," he told the welder.

Evans told a boilermaker to start on the siphon patch, then went to the office to see if he had any aspirin tablets.

There was two hours and forty minutes delay on 82 that evening waiting for an engine. He had to work the one that came in on the fast freight and run it through.

THREE days after Carter came to Plainville, the superintendent of motive power visited the place to see how things were going. The s.m.p. found the master mechanic supervising the construction of a walk. Not only was he supervising the construction, he was helping.

That morning Carter saw a laborer pushing a two-wheeled truck hauling a side rod to the blacksmith shop. The truck wheels sank in the dirt and it was tough going.

"Why haven't you got a walk from the roundhouse to the blacksmith shop?" Carter asked.

"I don't know," the laborer replied. "Just never have built one, I guess."

"Isn't there any old fire-brick around here?"

"Yes, sir; there's a lot of them loaded in a car to be hauled off," the laborer said.

"Well, get another man to help and start bringing them. We'll build a walk. No, take the side rod in the blacksmith shop first." The laborer had started to dump the rod on the ground and go after brick.

Carter lined up the walk and showed the laborers how

he wanted the brick laid. Three laborers were working on the job, two hauling bricks and one digging out a place to lay them. The laborer didn't get the brick laid evenly enough to suit the master mechanic, so he started laying them himself.

That's what he was doing when the superintendent of motive power found him. Carter was on his knees in the dirt. The three laborers were at the moment watching the official and listening with well simulated interest while he explained the fine art of making a walk of discarded fire-brick.

"Well, what have we got, a new straw-boss on the labor gang?" the superintendent of motive power asked.

Carter hadn't seen the superintendent of motive power come up. In fact, he didn't know he was anywhere near until he spoke. He rose from his knees. Carter's face was the color of a new red flag when he rose and faced the superintendent of motive power.

The master mechanic spent the next few days going over the division with the s.m.p. The laborers working on the walk gleefully broadcast what the s.m.p. had said. The nickname "straw-boss" stuck for many years. It's occasionally used even yet.

Carter should have learned his lesson at once, but he didn't. But remember, he had been a foreman for years and a master mechanic only a few days. When he returned from the trip over the division, he spent somewhat less time in the roundhouse than before, but he wasn't weaned, not by a lot.

The record on the Plains Division the first month Carter was there was nothing to brag about. Seven engine failures and more delays than he liked to think about is nothing to be proud of.

The second month was very little better and in some ways was worse. Overtime worked was excessive and the overrun of the monthly allowance caused such a howl from the head office that clerks thought the vice president in charge of operation had his tail caught in a crack.

As things got worse, Carter worked harder. As Carter worked harder, things got worse. The master mechanic tried personally to oversee every job that was done on the Plains Division, particularly at Plainville where most of the work is done. The official came down nights and stayed in the roundhouse hours at the time.

Foremen would tell the men to do a job in a certain way. The master mechanic would come along and tell them to do it differently without saying anything to the foreman. The men didn't know what to do. They became disgruntled and did less work than before.

Carter was trying, trying hard to do a good job. He drove himself mercilessly, sixteen and eighteen hours a day on the job, but conditions got worse. The master mechanic couldn't figure out where the trouble lay. He began to think that every one was working against him, that even the foremen were, to say the least, not trying to help him.

If the master mechanic didn't know what the trouble was, most every one else in the shops did. The men knew and discussed it freely among themselves. Machinist Johnson summed the situation up "when it gets like that, it's hell, and it's like that now."

Higher officials looked at records of performance at Plainville and shook their heads. "I thought Carter would make a good master mechanic," the general superintendent of motive power said one day, "but I guess I was mistaken."

THE human machine, like a locomotive, will stand only so much driving, then it's ready to go to the back-shop or scrap dock, depending on condition. Carter drove himself beyond endurance the first three months in Plainville. His eyes were usually red from loss of sleep. His voice became high-pitched and irritating. Every one that could, Evans included, dodged the "straw-boss" whenever they could.

Carter got to feeling so badly that he finally went to see a physician. "Nothing constitutionally wrong, just run down," the physician said.

"Then I'll be O.K. in a few days?" Carter asked.

"No, not a few days; a few weeks, providing you go to some place where you can rest and relax. Get your mind off the job while you still have a mind."

"Where should I go?"

"Go to Hot Springs for six weeks or two months," the doctor suggested.

"Man, I can't get away for two weeks, let alone six weeks or two months!" Carter objected.

"Well, that's up to you. You asked my advice; I've given it."

"And if I don't?"

"Complete nervous breakdown, months or even years to recover, maybe never. Why man, you're half dead on your feet right now and too hard-headed to admit it," the doctor exploded.

Carter went to Hot Springs. When he reached the sanitorium, physicians made him go to bed. It was two months before he returned to Plainville and the job.

That's what woke Carter up. The second month the master mechanic was gone, the division went without a single engine failure, the first time in years for such a record.

Two months in a sanitorium helped more ways than one. Carter went there a straw-boss with a title. He came back an official. There is some talk now of him being the next superintendent of motive power when Daniels retires next year.

Locomotive Boiler Questions and Answers

By George M. Davies

(This department is for the help of those who desire assistance on locomotive boiler problems. Inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless special permission is given to do so. Our readers in the boiler shop are invited to submit their problems for solution.)

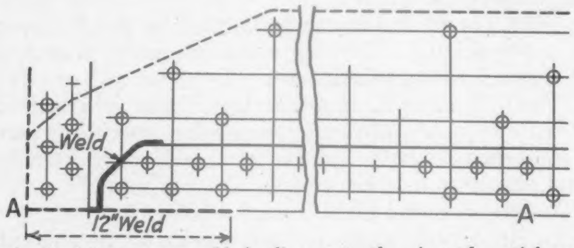
Why Weld the Ends of Longitudinal Butt Straps?

Q.—What is the purpose of welding around the ends of the outside straps of longitudinal seams?—A. L. P.

A.—The welding referred to is illustrated in the accompanying drawing and is used to secure a tight seam and eliminate the necessity of caulking the outside welt strap adjacent to the circumferential seam of the next course.

The 12-in. of welding along the front of the shell course, under the outside welt strap is used to insure a tight seam. The joint of the shell course to which the seam is attached is along the line *A-A*. Due to the fact that the edges of the inside welt strap are not caulked, the tightness of the seam is dependent upon the caulking of the outside welt strap. The caulking and welding of

the outside welt strap causes the seam to be tight at all points except the short space between the end of the butt strap and the shell plate of the adjacent course and for this reason same must be welded to insure a tight



Longitudinal butt strap welded adjacent to the circumferential seam

seam at this point. The weld is usually made about 12 in. long. Before welding was used at this point the seams were made tight by applying a ⅞-in. diameter screwed plug.

Why Is a Pyrometer Used on a Locomotive?

Q.—What is the purpose of a pyrometer on a locomotive and how does it work?—M. K.

A.—For the successful and economical operation of the locomotive, maximum superheat is just as essential as full boiler pressure. It is, therefore, necessary that some reliable means be provided to indicate to the engineman the temperature of the steam going to the cylinders. By indicating these temperatures, the superheated-steam pyrometer enables the engineman to check the performance of the locomotive and makes possible the highest standards of operation.

Locomotive superheaters are designed to develop steam temperatures of 600 to 750 deg. F. Any reduction of these temperatures, when the locomotive is working, indicates to the engineman that something is interfering with the proper performance of the superheater which can and should be corrected.

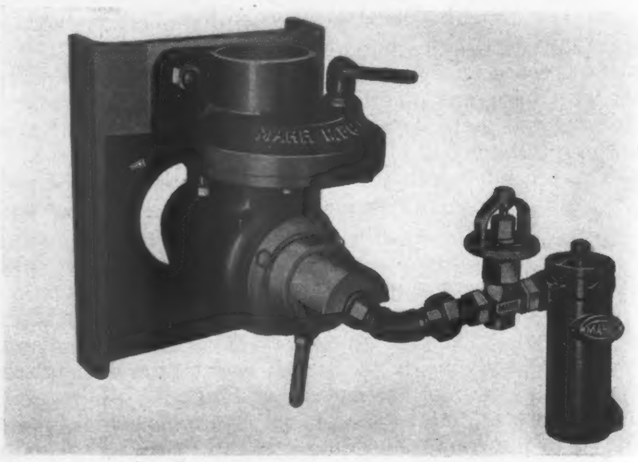
Plugged flues will restrict the flow of hot gases. Carrying water too high means that it must be evaporated in the superheater; a purpose for which it is not intended. Careless or indifferent firing, flue leaks, front-end air leaks, as well as improper draft adjustments, influence the superheat. The effect of any or all of these conditions is shown immediately on the dial of the superheated-steam pyrometer. The pyrometer conveys this information to the engineman in exactly the same manner as the steam gage registers the steaming qualities of the boiler; the principal difference being that the pyrometer indicates the defects before they have become serious enough to affect the steaming of the locomotive and register on the steam gage.

To indicate properly these variations in superheat, the pyrometer must be dependable, accurate, rugged, and sensitive, respond quickly to any change in temperature, and possess the same relative characteristics as the steam gage. The pyrometer is based on the thermocouple principle, by means of which an electric current is generated proportional to the difference in temperature between the hot and cold junctures of the thermocouple. The indicator itself consists of a millivoltometer actuated by the current generated at the thermocouple and moves a pointer on a calibrated dial, indicating the actual temperature of the steam.

The pyrometer equipment for each locomotive consists of three parts: the steam fixture, the indicator and the cable connecting the steam fixture to the indicator. The cables are furnished in five lengths (30 ft., 39 ft., 60 ft., or 75 ft.) to suit the size and type of the engine. The indicator is located in the cab at a convenient point on the back-head of the engine, and is furnished with either Fahrenheit or Centigrade scale as desired. The steam fixture contains the end of the thermocouple which is exposed to the flow of the superheated steam on its way to the cylinders. The slightest variation in the steam temperature immediately affects the previous voltage set up by the thermocouple and indicates this change on the dial in the cab. The cold junction of the thermocouple is at atmospheric temperatures, the variations of which are automatically compensated for.

Low-Pressure Oil Burners

The Mahr Manufacturing Company division of Diamond Iron Works, Inc., Minneapolis, Minn., recently announced a complete line of low-pressure triple-atomizing oil burners known as the 20 series. These burners, embodying a number of features which contribute to flexible and efficient operation when using all grades of fuel oil, are designed for use in industrial-heating operations.



One of the Mahr low-pressure series 20 oil burners—these burners can be used for low-pressure gas by interchanging the internal unit

All parts are accurately machined to insure uniform operation of all burners of the same size and to insure ease of parts replacement. By the removal of three cap screws and the oil connection, the entire atomizing unit may be removed for cleaning when necessary. The design of the blast gate and burner mounting is such that the entire body may be removed for repairs to the heat duct without disturbing the air line.

It is reported that the burners are extremely easy to light even with the heavier grades of oil and a cold furnace. They are free from oil drip and carbonizing in the heat duct. The air is controlled by a lever handle on the internal unit. Turning the handle to the right closes the air, the same as on any valve. The oil supply is controlled by the Mahr type G oil-regulating valve. Each burner is also equipped with one large fine-mesh oil strainer.

These same oil burners may also be used for burning high-pressure gas by installing the gas line in place of the oil line. For burning low-pressure gas, a special gas internal unit is installed in place of the oil internal unit. All parts are interchangeable and can be changed from one fuel to the other in a few minutes.

Among the Clubs and Associations

Master Boiler Makers' Association

Obviously, under present conditions, it will be impossible to hold large conventions of railway associations this year. Realizing this, the Master Boiler Makers' Association, as in the years 1935 and 1936, anticipates holding what might be termed a business meeting at the Hotel Sherman, Chicago, next September. If, however, conditions at that time are such that even a meeting of this type is not advisable, then the committee reports and special papers will be released in the form of printed proceedings and will be sent to the members. The following committees have been appointed to prepare such reports:

Topic No. 1—What means can or have been suggested to improve circulatory and other conditions in the locomotive boiler to eliminate leaky stays and cracked side sheets:

C. W. Buffington (chairman), general master boiler maker, Chesapeake & Ohio, Huntington, W. Va.
John F. Powers (vice-chairman), system boiler inspector, Chicago & North Western, Chicago.
John A. Doarnberger, general master boiler maker, Norfolk & Western, Roanoke, Va.
Walter R. Hedeman, assistant to chief of motive power and equipment, Baltimore & Ohio, Baltimore, Md.
D. A. Stark, general boiler and machinery inspector, Lehigh Valley, Sayre, Pa.
H. E. May, shop engineer, Illinois Central, Chicago.

Topic No. 2—Honeycombing and slagging of flues and tubes. Its cure and prevention:

Myron C. France (chairman), general boiler foreman, C. St. P. M. & O., St. Paul, Minn.
B. C. King (vice-chairman), general boiler inspector, Northern Pacific, St. Paul, Minn.
E. E. Owens, general boiler inspector, Union Pacific, Omaha, Neb.
Albert W. Novak, general boiler inspector, C. M. St. P. & P., Minneapolis, Minn.
Julius A. Kahn, general boiler foreman, Elgin, Joliet & Eastern, Joliet, Ill.

Topic No. 3—Which type of application of waist bearer angles or tees give the least trouble?

Edward H. Heidel (chairman), general boiler department foreman, C. M. St. P. & P., Milwaukee, Wis.
Louis R. Haase (vice-chairman), district boiler inspector, Baltimore & Ohio, Baltimore, Md.
H. H. Service, general boiler inspector, A. T. & S. F., Topeka, Kan.
W. M. Wilson, assistant general boiler inspector, C. R. I. & P., Kansas City, Mo.
William Freischlag, general boiler foreman, Wabash, Decatur, Ill.

Topic No. 4—Pitting and corrosion of locomotive boilers and tenders:

J. F. Becker (chairman), general boiler and machinery inspector, Chicago Great Western, Oelwein, Iowa.
J. M. Stoner (vice-chairman), supervisor of boilers, New York Central, Cleveland, Ohio.
W. B. Graham, chief mechanical inspector, International-Great Northern, Palestine, Tex.
Robert D. Merk, district boiler inspector, Great Northern, Spokane, Wash.
R. M. Cincoski, boiler department foreman, Northern Pacific, Livingston, Mont.

Topic No. 5—Prevention of cinder cutting of flues and tubes, firebox sheets, steam pipes, etc.

Sigurd Christopherson (chairman), supervisor of boiler inspection and maintenance, N. Y., N. H. & H., East Milton, Mass.
S. P. Mahanes (vice-chairman), district boiler inspector, Chesapeake & Ohio, Clifton Forge, Va.
H. M. Cooper, district boiler inspector, Baltimore & Ohio, Cincinnati, Ohio.
H. A. Bell, general boiler inspector, C. B. & Q., Lincoln, Neb.
O. H. Kobernik, general boiler foreman, N. Y. C. & St. L., Conneaut, Ohio.

Topic No. 6—What can be done to overcome the cracking of outside throat sheets?

M. V. Milton (chairman), chief boiler inspector, Canadian National, Toronto, Ont.
E. H. Gilley (vice-chairman), general boiler foreman, Grand Trunk Western, Battle Creek, Mich.
E. C. Umlauf, supervisor of boilers, Erie, Susquehanna, Pa.
R. A. Culbertson, district boiler inspector, Chesapeake & Ohio, Huntington, W. Va.
C. H. Pollock, foreman, boiler department, American Locomotive Company, Schenectady, N. Y.

Topic No. 7—In the application of flexible staybolts to boilers, which method gives the best results? (a) Screw the bolt up to a decided seat in the sleeve, cut to length and head over the bolt on the fixebox end. (b) Screw the bolt up to a decided seat in the sleeve and then turn back one-quarter turn before cutting to length and heading bolt over on the firebox end.

Leonard C. Ruber (chairman), superintendent of boiler department, Baldwin Locomotive Works, Darby, Pa.
A. D. O'Neill (vice-chairman), chief boiler inspector, Pere Marquette, Grand Rapids, Mich.
H. V. Stevens, assistant general boiler inspector, A. T. & S. F., Topeka, Kan.
Edward J. Brennan, general boiler department foreman, Boston & Maine, West Medford, Mass.
Frank A. Longo, welding and boiler supervisor, Southern Pacific, Los Angeles, Cal.
Frank Yochem, general boiler inspector, Missouri Pacific, St. Louis, Mo.
W. C. Masters, engineer, Flannery Bolt Company, Bridgeville, Pa.

Topic No. 8—Topics for 1938 meeting.

Carl A. Harper (chairman), general boiler inspector, C. C. C. & St. L., Indianapolis, Ind.
W. H. Kieler (vice-chairman), locomotive inspector, Bureau of Locomotive Inspection, I. C. C., St. Paul, Minn.
T. H. Moore, general boiler inspector, Western Maryland, Hagerstown, Md.
Anthony P. Lieder, general boiler inspector, Michigan Central, Jackson, Mich.
J. A. LaBlanc, boiler department foreman, Canadian National, Quebec, Que.

DIRECTORY

The following list gives names of secretaries, dates of next regular meetings, and places of meetings of mechanical associations and railroad clubs:

Air-Brake Association.—R. P. Ives, Westinghouse Air Brake Company, 350 Fifth avenue, New York.

American Railway Tool Foremen's Association.—G. G. Macina, 11402 Calumet avenue, Chicago.

American Society of Mechanical Engineers.—C. E. Davies, 29 West Thirty-ninth street, New York.
Railroad Division.—Marion B. Richardson, P. O. Box 205, Livingston, N. J.

Association of American Railroads.—J. M. Symes, vice-president operations and maintenance department, Transportation Building, Washington, D. C.
Mechanical Division.—V. R. Hawthorne, 59 East Van Buren street, Chicago.
Committee on Research.—William J. Cantley, mechanical engineer Lehigh Valley, Bethlehem, Pa.

Canadian Railway Club.—C. R. Crook, 2271 Wilson avenue, Montreal, Que. Regular meetings, second Monday of each month, except in June, July and August, at Windsor Hotel, Montreal, Que.

Car Department Association of St. Louis.—J. J. Sheehan, 1101 Missouri Pacific Bldg., St. Louis, Mo. Regular monthly meetings third Tuesday of each month, except June, July and August, Statler Hotel, St. Louis, Mo.

Car Department Officers' Association.—Frank Kartheiser, chief clerk, Mechanical Dept., C. B. & Q., Chicago.

Car Foremen's Association of Chicago.—G. K. Oliver, 2514 West Fifty-fifth street, Chicago. Regular meetings, second Monday in each month, except June, July and August, La Salle Hotel, Chicago.

Car Foremen's Association of Omaha, Council Bluffs and South Omaha Interchange.—H. E. Moran, Chicago Great Western, Council Bluffs, Ia. Regular meetings, second Thursday of each month at 1:15 p. m.

Central Railway Club of Buffalo.—Mrs. M. D. Reed, Room 1817, Hotel Statler, Buffalo, N. Y. Regular meetings, second Thursday each month, except June, July and August, at Hotel Statler, Buffalo.

Eastern Car Foremen's Association.—E. L. Brown, care of the Baltimore & Ohio, St. George, Staten Island, N. Y. Regular meetings second Friday of each month, except May, June, July, August and September.

Indianapolis Car Inspection Association.—R. A. Singleton, 822 Big Four Building, Indianapolis, Ind. Regular meetings, first Monday of each month, except July, August and September, at Hotel Severin, Indianapolis, at 7 p. m.

International Railway General Foremen's Association.—F. T. James (President), general foreman, D. L. & W., Kingsland, N. J.

International Railway Master Blacksmiths' Association.—W. J. Mayer, Michigan Central, 2347 Clark avenue, Detroit, Mich.

Master Boiler Makers' Association.—A. F. Stiglmeier, secretary, 29 Parkwood street, Albany, N. Y.

New England Railroad Club.—W. E. Cade, Jr., 683 Atlantic avenue, Boston, Mass. Regular meetings, second Tuesday in each month, except June, July, August and September, at Hotel Touraine, Boston.

New York Railroad Club.—D. W. Pye, Room 527, 30 Church street, New York. Meetings, third Friday in each month, except June, July, August and September, at 29 West Thirty-ninth street, New York.

Northwest Car Men's Association.—E. N. Myers, chief interchange inspector, Minnesota Transfer Railway, St. Paul, Minn. Meetings, first Monday each month, except June, July and August, at Midway Club rooms, University and Prior avenue, St. Paul.

Pacific Railway Club.—William S. Wollner, P. O. Box 3275, San Francisco, Cal. Regular meetings, second Thursday of each month in San Francisco and Oakland, Calif., alternately—June in Los Angeles and October in Sacramento.

Railway Club of Greenville.—J. Howard Waite, 43 Chambers avenue, Greenville, Pa. Regular meetings, third Thursday in month, except June, July and August.

Railway Club of Pittsburgh.—J. D. Conway, 1941 Oliver Building, Pittsburgh, Pa. Regular meetings, fourth Thursday in month except June, July and August, Fort Pitt Hotel, Pittsburgh, Pa.

Railway Fuel and Traveling Engineers' Association.—T. Duff Smith, 1255 Old Colony building, Chicago.

Southern and Southwestern Railway Club.—A. T. Miller, P. O. Box 1205, Atlanta, Ga. Regular meetings, third Thursday in January, March, May, July and September. Annual meeting, third Thursday in November, Ansley Hotel, Atlanta, Ga.

Toronto Railway Club.—D. M. George, Box 8, Terminal A, Toronto, Ont. Meetings, fourth Monday of each month, except June, July and August, at Royal York Hotel, Toronto, Ont.

Western Railway Club.—C. L. Emerson, executive secretary, 822 Straus Building, Chicago. Regular meetings, third Monday in each month, except June, July, Aug. and Sept.

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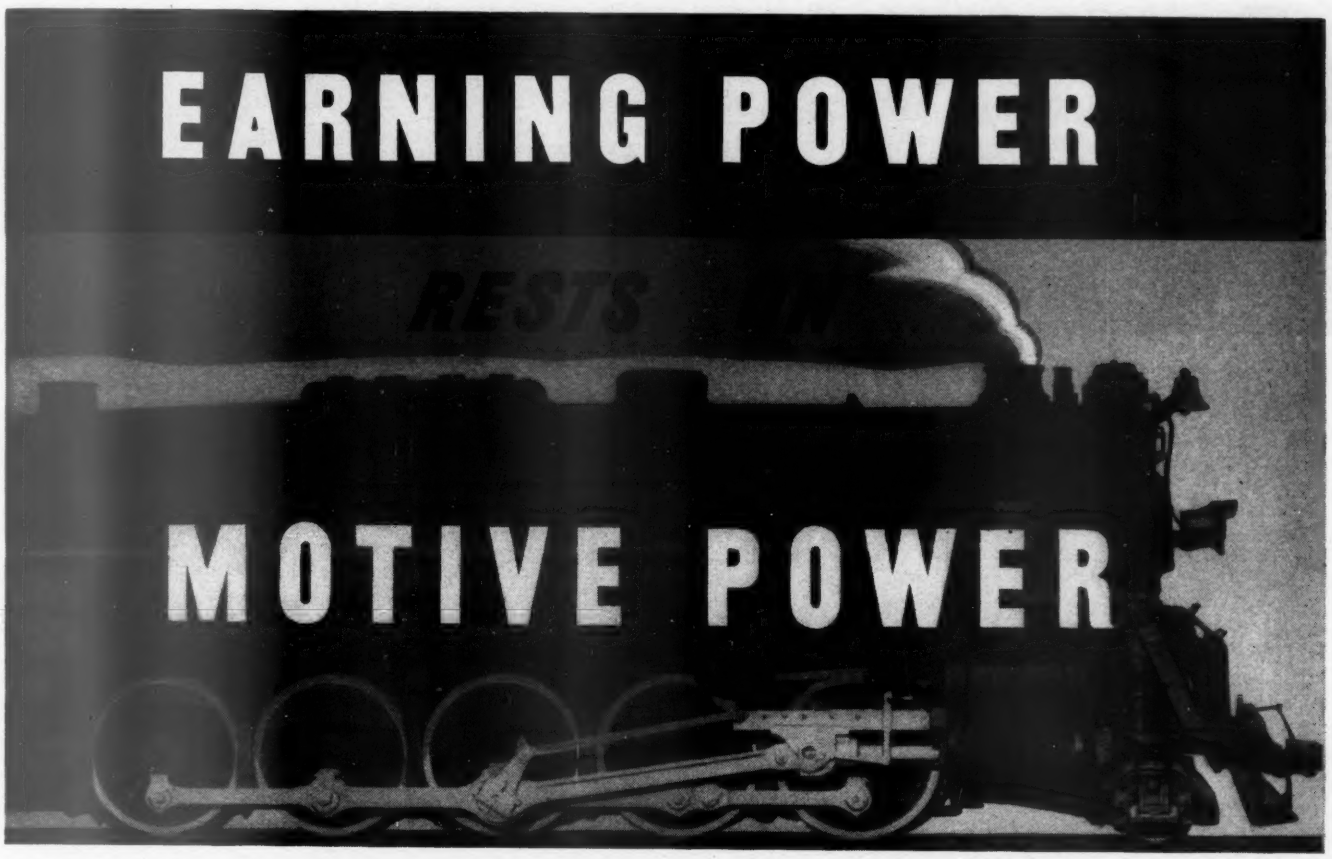

The increased earning ability of modern motive power justifies the replacement of many thousands of existing locomotives. ● Let earning power be the consideration that governs your choice between repairing old power or buying new locomotives. ● Do not perpetuate old locomotives that will be a drain on increasing revenues.

LIMA LOCOMOTIVE WORKS INCORPORATED

LIMA LOCOMOTIVE WORKS, INCORPORATED, LIMA, OHIO

A Group of New Santa Fe Lightweight Trains at the Chicago Terminal

NEWS

Improvement Programs

The Southern Railway System is renovating and air conditioning certain passenger coaches at an authorized cost of approximately $1,033,000. The program is expected to be completed late this spring.

Chicago, Milwaukee, St. Paul & Pacific.—A budget of $6,058,870 for the Milwaukee has been approved by the federal district court at Chicago. Of the total, about $3,000,000 is for new equipment to be financed out of railroad funds.

Power Reverse Gear Order Is Modified

The Interstate Commerce Commission has modified its order in the power reverse gear case so that carriers may be permitted to install power reverse gears when class 1 or 2 repairs are made. The original order required the installation to be made when class 3 or heavier repairs were made.

Car Inspector Covered by Federal Safety Appliance Act

A car inspector who is injured while inspecting at an interchange point a foreign car not yet accepted by the road employing him may claim benefits under the Federal Safety Appliance Act, such damages to be paid by the delivering carrier, according to a recent decision of the United States Supreme Court reversing a previous judgment of the Supreme Court of the State of Missouri in Brady v. Terminal Railroad Association of St. Louis, 1025 W. (2) 903. According to the testimony rendered in the case, the Terminal Railroad Association had placed a string of cars on an interchange track of the Wabash at Granite City, Ill., where they awaited acceptance by the latter. When Brady, a Wabash car inspector, followed his usual routine of inspecting the cars, prior to acceptance by the Wabash, he chanced to secure himself by a grab-iron which had become loose, due to a rotten board; he fell and was injured.

The plaintiff first sued the Wabash under the Federal Safety Appliance Act, but a judgment in his favor was reversed on the ground that the car had not yet been accepted by the Wabash. While that suit was pending, Brady brought a new suit against the Terminal Railroad Association in the state court.

In its decision in this case, which it accepted on appeal from an adverse judgment by the state court, the United States Supreme Court held that when Brady was injured the defective car was still in use by the defendant carrier, since it had not yet been accepted by the Wabash, and that the statutory obligation of the terminal road continued. During the trial, it was questioned also whether the fact that Brady was not an employee of the Terminal Railroad Association did not absolve the road from duty to him. To this the high court replied that the car inspector was not beyond the statute of the act unless he was outside its scope because of the special character of his work. Since it was of the

(Continued on next left-hand page)

New Equipment Orders and Inquiries Announced Since the Closing of the March Issue

Locomotive Orders

Road	No. of Locos.	Type of Loco.	Builder
Canadian Pacific	15	4-6-2	Canadian Loco. Co.
	10	Hudson	Montreal Loco. Wks.

Locomotive Inquiries

Chicago & North Western	1–6	15,000-gal. tenders	....

Freight-Car Orders

Road	No. of Cars	Type of Car	Builder
Bangor & Aroostook	500	40-ton box	Magor Car Corp.
	115	70-ton hopper	Bethlehem Steel Co.
	50	50-ton rack	Greenville Steel Car Co.
British American Oil Co., Ltd.	5	Tank	Canadian Car & Fdry. Co.
	24	Tank	National Steel Car Corp.
Canadian National	700*	45-ton box	Eastern Car Co.
	700*	45-ton box	National Steel Car Corp.
	600*	45-ton box	Canadian Car & Fdry. Co.
Canadian Pacific	1,000	40-ton box	Canadian Car & Fdry. Co.
	50	Automobile	Canadian Car & Fdry. Co.
	200	Flat	Canadian Car & Fdry. Co.
	200	Stone	Canadian Car & Fdry. Co.
	950	40-ton box	National Steel Car Corp.
	100	Gondola	National Steel Car Corp.
	200	50-ton hopper	National Steel Car Corp.
	50	Concentrate	Eastern Car Co.
	50	Refrigerator	Canadian Pacific shops
Canfield Tank Line	4	Tank	General American Trans. Co.
Niagara Smelting Corp.	1	Tank	General American Trans. Co.
Phillips Petroleum Co.	10	Propane tank	General American Trans. Co.
Shell Chemical Co.	4	Tank	General American Trans. Co.
U. S. Navy Dept.	5	50-ton flat	American Car & Fdry. Co.
	1	100-ton flat	Haffner-Thrall Car Co.
	1	50-ton hopper	American Car & Fdry. Co.

Freight-Car Inquiries

Eastern Gas & Fuel Associates	50	50-70-ton hopper	....
	5–10	Tank	....

Passenger-Car Orders

Road	No. of Cars	Type of Car	Builder
Bangor & Aroostook†	1	Baggage and mail	Pullman-Std. Car Mfg. Co.

* These cars, which will be steel-sheathed, with wood linings and ceilings, will be wider and higher than the 3,000 built last year. They will have a length of 40 ft. 6 in., and will be 9 ft. 2 in. wide and 10 ft. high, with a capacity of more than 3,700 cu. ft. The weight of the car will be 1,700 lb. lighter than the previous lot.

† Ordered by Bangor & Aroostook Investment Co.

opinion that Congress had made no exception of those employed in inspecting cars and that the statute expressly excludes the legal defense of assumption of risk, the Court concluded that "one is not to be denied the benefit of the Act because the work was that of inspection for the purpose of discovering defects." The opinion was rendered by Chief Justice Hughes.

Relation Between Track and Rolling Stock

THE Engineering Division (A. R. E. A.) and the Mechanical Division of the Association of American Railroads have appointed a joint committee to study the relation between track and rolling stock through a program of investigation and tests relating thereto. The committee is headed by Dr. Arthur N. Talbot, professor emeritus, University of Illinois, Urbana, Ill. Representatives of the A. R. E. A. include J. V. Neubert, chief engineer maintenance of way, N. Y. C., New York; W. J. Burton, assistant to chief engineer, M. P., St. Louis, Mo.; A. N. Reece, chief engineer, K. C. S., Kansas City, Mo.; and Robert Faries, assistant chief engineer, maintenance, Penna., Philadelphia, Pa.

The Mechanical Division has appointed the following: R. H. Kueck, chief mechanical engineer, M. P., St. Louis, Mo.; J. B. Blackburn, mechanical assistant to chief mechanical officer, C. & O., Cleveland, Ohio; J. G. Blunt, chief mechanical engineer, American Locomotive Co., Schenectady, N. Y.; F. A. Isaacson, engineer car construction, A. T. & S. F., Topeka, Kan.; and A. G. Hoppe, assistant mechanical engineer, C. M. St. P. & P., Milwaukee, Wis. W. I. Cantley, mechanical engineer, Mechanical Division, and G. M. Magee, research engineer, Engineering Division, will participate ex-officio in the activities of the committee.

Employment Still Dropping

RAILWAY employment fell off another 2.08 per cent during the one-month period from mid-January to mid-February, according to the Interstate Commerce Commission's compilation, based on preliminary reports. The total number of employees as of the middle of February was 939,663, as compared with a mid-January figure of 959,670.

The drop in maintenance of equipment and stores forces was 3.33 per cent while the train and engine service group was down 2.87 per cent, reflecting the fall in traffic. The mid-February maintenance of way and structures force was 1.31 per cent smaller than that of the previous month.

The drop in total employment as compared with February, 1937, was 14.26 per cent, with maintenance of way and structures forces falling off 19.3 per cent; maintenance of equipment and stores, 21.54 per cent; and train and engine service, 13.86 per cent. The index number, based on the 1923-1925 average as 100 and corrected for seasonal variation, stood at 54.7 in February as compared with 63.8 in February, 1937.

Rock Island Leases Diesel-Electric Power

THE CHICAGO, ROCK ISLAND & PACIFIC has, with the consent of the federal district court at Chicago, completed negotiations with the Electro-Motive Corporation for the lease of 10 Diesel-electric switching locomotives for a period of seven years. The locomotives include eight 100-ton, 600-hp. and two 125-ton, 900-hp. locomotives. The gross rental for each of the 100-ton locomotives will be $67,500 and the total rental on the larger ones will be $88,000 each. At the conclusion of the rental period, the road may purchase the locomotives at a nominal cost. The petition of the road to the court stated that ten Diesel switching locomotives, similar to the 100-ton locomotives just obtained, were leased from the Electro-Motive Corporation on April 20, 1937, resulting in a savings of approximately $1,000 a month to the road after the payment of rental.

Fuel Efficiency Record in 1937

AN improved record in fuel efficiency by locomotives engaged in road and yard service was established by the railroads of the United States in 1937, according to the Association of American Railroads. In that year an average of 117 lb. of fuel was required to haul 1,000 tons of freight and equipment a distance of one mile. This was the lowest average attained since the compilation of these reports began in 1918.

The average in 1937 was a reduction of nearly 28 per cent compared with 1921, in which year the average was 162 lb. It also was a reduction of 2 lb. compared with 1936 and a reduction of 3 lb. compared with 1935.

Increased efficiency in fuel consumption in passenger service also took place in 1937. In that year, 15.1 lb. of fuel were required to haul each passenger-train car one mile. This was a reduction of nearly 15 per cent compared with 1921 when the average was 17.7 lb. The average in 1936 was 15.3 lb. and in 1935 it was 15.5 lb.

Class I roads in 1937 used 82,276,671 tons of coal for both road and yard switching service. This was obtained at a cost of $198,953,973. In 1936, they used 80,439,186 tons, the cost of which was $188,572,369. The railroads also consumed in road and yard switching service in 1937, 2,553,723,894 gal. of fuel oil, compared with 2,336,421,839 gal. in 1936.

Equipment Depreciation Orders

EQUIPMENT depreciation rates for six railroads, including the Virginian and the Clinchfield, have been prescribed by the Interstate Commerce Commission in another series of sub-orders modifying previous sub-orders in No. 15100, Depreciation Charges of Steam Railroad Companies. The composite percentages which are not prescribed rates range from 3.07 per cent for the Clinchfield to 11.94 per cent for the Sabine & Neches Valley.

The Virginian's composite percentage of 3.26 is derived from the following prescribed rates: Steam locomotives, 3.65 per cent; other locomotives, 2.82 per cent; freight-train cars, 3.25 per cent; passenger-train cars, 3 per cent; work equipment, 3.87 per cent; miscellaneous equipment, 15 per cent. Prescribed rates for the Clinchfield are: Steam locomotives, 3.21 per cent; freight-train cars, 3 per cent; passenger-train cars, 3.14 per cent; work equipment, 2.81 per cent.

Illinois Central Adopts Plan to Reduce Payroll Expense

A PLAN providing for the reduction of payroll expense by the elimination of positions and by vacations without pay has been placed in effect by the Illinois Central. Under the plan all employees, including officers, will contribute to the payroll reduction so that no particular group will be called upon to bear the entire burden. In that group of employees which enjoys wage and working contracts through the Brotherhoods, a ten per cent reduction in payroll is being accomplished through the elimination of positions. In the group of employees not covered by contracts, including officers not under contract, each employee is required to take ten days vacation without pay during April or May at such time as the employee chooses and work permits. The ten days may or may not be consecutive.

Supply Trade Notes

THE MODERN SUPPLY COMPANY, Chicago, has been appointed sales representative for the Standard Brake Shoe & Foundry Company, Pine Bluff, Ark.

GEORGE KEMME, railway sales and service engineer for the Standard Oil Company, Minneapolis division, with headquarters at Minneapolis, Minn., has retired.

H. E. LEWIS, chairman of the board of the Jones & Laughlin Steel Corporation, Pittsburgh, Pa., has also been elected president to succeed S. E. Hackett, resigned. Lewis M. Parson, who has been in charge of the Philadelphia sales office of the Bethlehem Steel Company, has been elected a director and vice-president in charge of sales of the Jones & Laughlin Steel Corporation.

J. W. KEARNEY recently became associated with the Davis Brake Beam Company, Johnstown, Pa. Mr. Kearney's headquarters are at 908 Midland building, Cleveland, Ohio.

C. C. SCOTT, manager of the Buffalo, N. Y., sales office of the Worthington

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Pump and Machinery Corporation, Harrison, N. J., has been assigned to special work in the Buffalo district and has been succeeded by W. A. Meiter, representative for the Cleveland, Ohio, territory.

The Wilson Engineering Corporation, Chicago, has been appointed distributor for the railway equipment manufactured by The Unit Heater & Cooler Co., Wausau, Wis., a division of the D. J. Murray Manufacturing Company of the same city.

Frank P. McEwen, formerly with the Republic Steel Corporation, has been elected vice-president and assistant to president of the Ewald Iron Company, with headquarters at Louisville, Ky., to succeed George O. Boomer, resigned.

James T. Hamilton has been appointed district manager, Eastern division of the Railway division of the Dayton Rubber Manufacturing Company, Dayton, Ohio, and Charles F. Howard, who has had practical experience on railway air conditioning equipment, has been appointed service inspector in the Eastern region for the railway division. Mr. Hamilton, after graduating from Bliss Electrical School, Washington, D. C., served as a special apprentice on the New York, New Haven & Hartford. In 1920 he resigned as assistant mechanical superintendent and assumed charge of rolling stock on the New York, Westchester & Boston as superintendent of car equipment, but later left this road to become car equipment engineer with Jackson & Moreland, consulting engineers on the Delaware, Lackawanna & Western electrification. On completion of this project, he entered the sales field as eastern railway sales manager for a storage battery company. He then assisted in organizing the car maintenance department of the City of New York Independent System, and later in the maintenance of its car equipment.

J. T. Hamilton

J. M. Taylor, vice-president and manager at New Orleans, La., of the New Orleans Building Materials District of the Johns-Manville Sales Corporation has been transferred from the management of that district to the staff of the president of the sales corporation, with headquarters, as formerly, at New Orleans. Mr. Taylor continues as vice-president of the sales corporation, but has been relieved of the duties of district managership to devote more of his time to this special assignment.

Lewis M. Parsons, formerly manager of sales of the Bethlehem Steel Company, with headquarters at Philadelphia, Pa., has been elected vice-president in charge of sales and a director of the Jones & Laughlin Steel Corp., Pittsburgh, Pa. Mr. Parsons was educated at the University of Pennsylvania and in 1917 entered the destroyer service of the U. S. Navy. Later in the World War he served in the Naval Flying Corps. After the war, he entered the employ of the Bethlehem Steel Company in the sales division and was made assistant manager of sales at Philadelphia in 1932. In 1936 he became manager of sales at the same office.

Lewis M. Parsons

A new board of directors of The Baldwin Locomotive Works was elected at the annual meeting of the company held at Philadelphia, Pa., on March 3. The board elected at the meeting, the first to be held since confirmation of the reorganization plan, is made up as follows: Arnold Bernhard, of New York; Charles E. Brinley, John W. Converse, Joseph N. Ewing, Edward Hopkinson, Jr., George H. Houston, Conrad N. Lauer, all of Philadelphia; Jerome Preston, of Boston, Mass.; Charles H. Schlacks, of Philadelphia; Robert C. Shields, of Detroit, Mich.; Charles L. Stillman, of New York; and Samuel M. Vauclain, of Philadelphia.

The new members of the board are Messrs. Bernhard and Brinley, who are also voting trustees; Converse, Hopkinson, Preston, Schlacks and Stillman.

At the organization meeting of the board, held on March 7, the following officers were re-elected to serve for the ensuing year: Samuel M. Vauclain, chairman of the board; George H. Houston, president; Robert S. Binkerd, vice-president and director of sales; Harry Glaenzer, vice-president in charge of engineering; Charles E. Acker, treasurer; Charles D. MacGillivray, secretary; James Macdonald, assistant secretary; Howard D. Humphrey and Thomas E. McFalls, assistant treasurers.

In addition the following executive committee was elected: Conrad N. Lauer, chairman, Arnold Bernhard, Charles E. Brinley, Edward Hopkinson, Jr., George H. Houston, Robert C. Shields, and Samuel M. Vauclain.

F. B. Horstmann has been appointed technical director, railroad department, of the Dearborn Chemical Company, Chicago, with duties to include the general supervision of all railroad department matters falling under that head.

George T. Mahaney of the staff of the general sales manager of the Chevrolet Motor division of the General Motors Corporation and James D. Platt, district manager of the Pontiac Motor division, with headquarters at Seattle, Wash., have been appointed eastern and western sales managers, respectively, of the Diesel Engine division of General Motors Sales Corporation, with headquarters in Cleveland, Ohio. The two territories will be divided roughly by a line extending from Mobile, Ala., northward through Chicago and Milwaukee, Wis.

J. A. Amos, vice-president of the Pyle-National Company, Chicago, has been elected president to succeed William Miller, who has been elected chairman of the board. Mr. Amos has been with the Pyle-National Company since 1926, when he entered its employ as vice-president. Prior to that time he was associated with various companies until 1918, when he established the Oliver Electric Appliance Company, at St. Louis. In 1924, this company was sold to the Pyle-National Company and was operated as an independent business until 1926, when it was merged with Pyle-National and Mr. Amos was elected vice-president.

J. A. Amos

Mr. Miller's experience embraces several years of railroad service prior to 1908, when he became vice-president of the Adreon Manufacturing Company. Three years

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later he was elected president of the Monarch Pneumatic Tool Company and vice-president of the Standard Railway Equipment Company, from which position he resigned in 1913 to become vice-president

William Miller

of the Pyle-National Company. In 1914 he was elected senior vice-president and on August 2, 1934, was elected president, which position he has held until his recent appointment.

THE T-Z RAILWAY EQUIPMENT COMPANY, Chicago, has been appointed national sales representative for the distribution of railway specialties manufactured by the Motor Wheel Corporation, Lansing, Mich., which includes primarily steel car stampings, such as coil-spring plates, journal-box lids, dust-guard assemblies, triple-valve protector caps and defect- and routing-card holders.

THE officers of the Greenville Steel Car Company, Greenville, Pa., are now as follows: Edwin Hodge, Jr., of Pittsburgh, chairman and president, succeeding Frank L. Fay, who has resigned; W. S. Dietrich, vice-president in charge of operation; K. C. Gardner, continues as vice-president in charge of sales; R. A. Zimmerman is treasurer and assistant secretary, and John C. Bane, Jr., is secretary and assistant treasurer.

Obituary

CORNELIUS G. SAUERBERG, mechanical representative of the Ohio Injector Company of Illinois, Chicago, with headquarters at Castleton-On-Hudson N. Y., died in Mason City, Iowa, on February 24. He was born on January 13, 1884, and graduated from Iowa State College in 1911. Following his graduation he entered the employ of the Atchison, Topeka & Santa Fe, serving in various capacities in the mechanical department of that railroad until 1919, when he engaged in business for himself in Mason City. In September, 1924, he was employed by the Ohio Injector Company of Illinois as mechanical representative and service engineer, at Castleton-On-Hudson.

ROBERT R. WELLS, representative for the western territory of the Hunt-Spiller Manufacturing Corporation, South Boston, Mass., died on February 23, of a heart ailment at his home in Berkeley, Calif. Mr. Wells was born at Topeka, Kan., on February 7, 1885, and during his early career was employed by the Atchison, Topeka & Santa Fe. He subsequently was an inspector at the steel plants in Chicago and then was with the United States Metallic Packing Company previous to March 15, 1923, when he entered the service of the Hunt-Spiller Manufacturing Corporation as a representative in its sales department for the western territory.

Personal Mention

General

R. V. BLOCKER, assistant superintendent of motive power of the Erie, with headquarters at Cleveland, Ohio, has been appointed superintendent of motive power to succeed Charles James, retired.

W. E. HARMISON, master mechanic of the Erie at Hornell, N. Y., has been promoted to assistant to the superintendent of motive power, with the same headquarters. The position of assistant superintendent of motive power has been abolished.

CHARLES JAMES, superintendent of motive power of the Erie at Cleveland, Ohio, has retired. Mr. James was born in Elkhart, Ind. Before coming to the Erie as a machinist in 1890 he had spent ten years in the Elkhart shops of the Lake Shore & Michigan Southern (now part of the New York Central). On the Erie he became enginehouse foreman at Huntington, Ind., and later general foreman at Chicago. After serving as master mechanic at Avon, N. Y.; Galion, Ohio; Port Jervis, N. Y., and Jersey City, N. J., he became district mechanical superintendent of the Western district, later being transferred to the Hornell region. He was appointed superintendent of motive power on November 1, 1927.

J. M. NICHOLSON, acting mechanical superintendent of the Western mechanical district of the Eastern lines of the Atchison, Topeka & Santa Fe, has been appointed mechanical superintendent of the same territory, with headquarters as before at Topeka, Kan., succeeding I. C. Hicks, who is retiring at his own request, after 35 years' service with this company. Mr. Nicholson was born in Scranton, Kan., on February 24, 1888. After graduating from Kansas State College he entered the test department of the Santa Fe on September

J. M. Nicholson

16, 1912, as a computer. In June, 1913, he was promoted to an assistant in this department, and on May 1, 1916, to laboratory foreman. The following August he was made fuel supervisor on the Missouri and Illinois divisions. He was promoted to assistant engineer of tests on May 26, 1921, and became fuel conservation engineer for the system on January 1, 1923. Mr. Nicholson was promoted to master mechanic on November 1, 1930, serving first on the Slaton division, then, after February 1, 1934, on the Eastern and Kansas City divisions, and, after July 1, 1937, on the Illinois division. He was appointed acting mechanical superintendent of the western district of the Eastern lines on July 20, 1937.

Master Mechanics and Road Foremen

EDWARD POOL, master mechanic of the Erie at Marion, Ohio, has been appointed master mechanic at Hornell, N. Y.

CHESTER K. JAMES has become master mechanic of motor equipment of the Erie, with headquarters at Hornell, N. Y.

C. J. GERBES, master mechanic of the Erie at Avoca, Pa., has been appointed master mechanic at Marion, Ohio.

HARVEY H. JONES has been appointed master mechanic of the Wyoming division of the Union Pacific, with headquarters at Cheyenne, Wyo., succeeding R. F. Weiss.

LESLIE FORAKER has been appointed road foreman of engines on the Susquehanna division of the Erie, succeeding L. D. Burdell.

C. W. ECENBARGER, general enginehouse foreman of the Erie at Port Jervis, N. Y., has been promoted to the position of master mechanic at Avoca, Pa., to succeed C. J. Gerbes.

L. D. BURDELL has been appointed road foreman of engines on the Meadville and B. & S. W. divisions of the Erie.

B. E. JONES, master mechanic of motor equipment of the Erie, with headquarters

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On the New York Central

WHEN it came to motive power for the new deluxe streamlined 20th Century Limited, the New York Central demonstrated their implicit confidence in steam by again selecting the reliable time-tested, service-proved Hudson type locomotive. And why not?—For twelve years this fast passenger locomotive, hauling all the famous trains of the New York Central, has been making most exacting schedules with sunrise certainty. Now, with this long continued success with steam, 50 more improved Hudsons, ten of which are attractively streamlined for the Century, are being delivered, raising the total number of Hudsons on the Central to 275.

The construction of these 275 engines brought continued improvements in both proportions and mechanical details making each successive class of Hudsons more powerful, efficient and serviceable than the one before. These new engines develop more than 4,700 cylinder horsepower at 75 miles per hour. At 80 miles per hour they produce a drawbar pull of 17,500 pounds or 30 per cent more than the pull exerted by previous Hudsons at the same speed. Most important of all, this outstanding performance is delivered at a relatively low first cost.

Steam is still supreme on the New York Central.

AMERICAN LOCOMOTIVE COMPANY

30 CHURCH STREET · NEW YORK · N·Y·

at Hornell, N. Y., has been appointed master mechanic at Buffalo, N. Y., to succeed William Moore.

Car Department

JAMES F. MONGER, who has been appointed superintendent of the car shops of the Illinois Central at Burnside (Chi-

J. F. Monger

cago), as noted in the December issue of the *Railway Mechanical Engineer,* was born in Loudon County, Tenn., on September 6, 1885. He received a grammar school education and entered railway service on September 1, 1912, as a gang foreman with the Illinois Central & Yazoo & Mississippi Valley at Memphis, Tenn. On May 1, 1917, he became a general car foreman at Vicksburg, Miss., and on March 16, 1934, general car foreman at Burnside. On November 1, 1937, Mr. Monger was appointed shop superintendent.

EDWARD M. JENKINS, master car builder of the Delaware, Lackawanna & Western at Scranton, Pa., has retired.

FRANK A. SHOULTY has recently been appointed assistant superintendent of the car department of the Chicago, Milwaukee, St. Paul & Pacific, with headquarters at Milwaukee, Wis.

ROLAND H. LLOY, car foreman of the Canadian National at Halifax, N. S., has been appointed acting general car foreman, succeeding W. H. Pirie.

Shop and Enginehouse

F. D. RIPLEY, assistant foreman of the Norfolk & Western at Eckman, W. Va., has been promoted to the position of foreman, succeeding W. H. Show.

ALEXANDER D. McDONALD, night enginehouse foreman of the Canadian National at Mulgrave, N. S., has become acting day foreman of the enginehouse.

WILLIAM MOORE, master mechanic of the Erie at Buffalo, N. Y., has been appointed shop superintendent, with headquarters at Hornell, N. Y.

J. R. HARRIS has been appointed production engineer of the Chicago, Milwaukee, St. Paul & Pacific, with headquarters at Milwaukee, Wis.

R. M. WILSON has been appointed general foreman of the Erie at Port Jervis, N. Y., succeeding C. W. Ecenbarger.

JAMES E. STANTON, boilermaker of the Canadian National at Mulgrave, N. S., has been appointed acting night foreman.

EARL C. KELLOCK has been appointed acting enginehouse foreman of the Canadian National, with headquarters at Stellarton, N. S., succeeding James Blair, who has retired.

Obituary

G. W. ROBERTSON, master mechanic of the Chesapeake & Ohio at Clifton Forge, Va., died on February 9.

GEORGE TOZZER, who retired as purchasing agent of the Big Four in 1917, died in Cincinnati, Ohio, January 22, at the age of 87.

J. G. HILGEN, division storekeeper of the Chesapeake & Ohio, with headquarters at the Russell car shops, Russell, Ky., died suddenly at his home on February 1, at the age of 48 years.

Trade Publications

Copies of trade publications described in the column can be obtained by writing to the manufacturers. State the name and number of the bulletin or catalog desired, when mentioned in the description.

LANDIS HYDRAULIC GRINDER.—The Landis 16-in. Type B plain hydraulic grinder is illustrated and described in Catalog E-37 issued by the Landis Tool Company, Waynesboro, Pa.

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NICKEL ALLOY STEELS FOR HAND TOOLS.—Bulletin U-3, issued by The International Nickel Company, Inc., 67 Wall street, New York, describes nickel alloy steels for hand tools and small power tools, such as wrenches, hammers, screw drivers, pliers, chisels, rivet sets, punches, etc.

◆

VANADIUM STEEL CASTINGS.—The 24-page illustrated bulletin issued by the Vanadium Corporation of America, 420 Lexington avenue, New York, contains a complete description of the properties and applications of a number of vanadium alloy steels for castings where high strength is required without excessive weight or high cost. Carbon-vanadium steel, manganese-vanadium steel, nickel-vanadium steel and nitriding cast steel are among the alloy steels discussed.

◆

MONEL, NICKEL *and* NICKEL ALLOYS.—Bulletins T13 and T-14, issued by the Development and Research Division of the International Nickel Company, Inc., 67 Wall street, New York, discuss, respectively, nickel and nickel-base alloys—their use in the design of corrosion-resistant machinery and equipment, and the design and construction of heavy equipment in monel, nickel and Inconel.

◆

MACHINING ALUMINUM.—Part I of the completely revised edition of "Machining Aluminum," issued by the Aluminum Company of America, Pittsburgh, Pa., deals with cutting angles and shapes for various tools for general machine-shop practice, and discusses cutting speeds, feeds, lubricants and tool materials. Part II is concerned with speeds, feeds, cutting compounds, tool materials and various tools used for screw-machine practice.

◆

TURRET LATHES.—A 20-page booklet, being distributed by the Gisholt Machine Company, Madison, Wis., gives a pictorial record and general description of the complete line of turret lathes manufactured by this company. As described in the booklet, these machines range from the No. 3 universal ram-type turret lathe, having a 1½-in. spindle bore to the largest No. 5L heavy-duty type, having a 12¼-in. spindle bore. Two types of automatic lathes, static and dynamic balancers, a tool-grinding machine, also chucks, machine attachments, boring bars, etc., are described. The unit structural features in the design of these turret lathes are clearly illustrated and their advantages pointed out. Another 24-page catalog illustrates Gisholt standard tools for 1L and 2L high-production turret lathes.

◆

TIMKEN ENGINEERING JOURNAL.—The fifth edition of The Timken Engineering Journal, issued by The Timken Roller Bearing Company, Canton, Ohio, contains a complete revision of the General Information Section. The volume of 294 loose-leaf pages, furnished in a standard 8½-in. by 11-in. three-ring binder, with stiff covers, includes a general discussion of the types of Timken bearings now available, a discussion of ratings and bearing selection, methods used for calculating bearing loads for a wide range of fundamental applications, and complete detailed information as to bearing sizes and load-carrying capacity. Full- and half-size detail bearing drawings for single-row Timken bearings up to an outside diameter of 14 in. are also presented. Supplementary sections cover applications in such special fields as conveyors, shop trucks, oil field equipment, etc.